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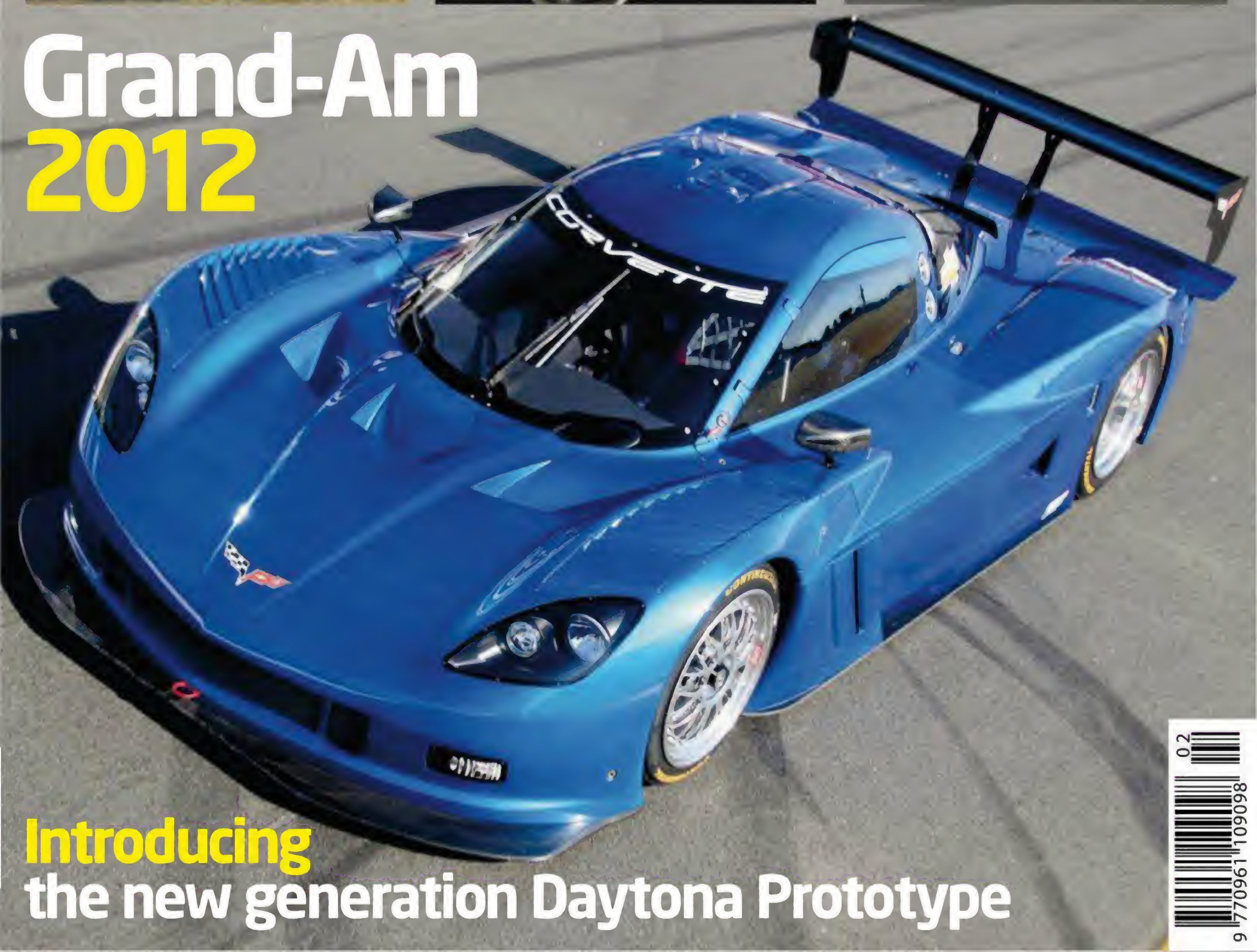

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Applied science

How large a real-world difference can be ascribed to motorsport?

The revelations (unconfirmed as this is written) that Red Bull use exhaust heat to warm tyres for fast first laps happily confirms that technical diversity and innovation are still alive. Few other sporting environments provide any regular innovation, and especially not innovation that may improve the world at large, even if hot tyres perhaps don't make that grade!

Tennis, for example, is no doubt as competitive as racing but what does their sport leave behind? Court, racket and balls have not changed dramatically and, even where innovation in materials has occurred, any advances have not been much use to the general public.

Sport research is best when it produces something useful and independent of the sport. However, most sports suck in innovation from outside, eg carbon fibre tennis rackets, while motorsport instead sometimes exports the products of its innovation with lasting success.

The iconic case of the rear view mirror invented by a racer rather than a manufacturer illustrates the point that, whilst most people will not have heard of the man who added the first mirror to his racecar, we now all use them on the roads.

More modern successes include Ron Dennis, who retired from his Formula 1 team to focus on the McLaren corporation that had grown out of the composite business it started using skills and knowledge from their first composite tubs. Recently, Patrick Head announced he was to step down from the Williams team to run their KERS related spin-off.

But other than individual examples, how large a real-world difference can be ascribed to motorsport innovation?

American and European motorsport have very different origins. The European invention of the car led manufacturers to test vehicles on public roads. Cars were expensive and unreliable, but their wealthy owners had grown up with horse racing and keenly undertook competitive 'point-to-point' events with their vehicles. The car manufacturers realised these events were good for testing and advertising so supported them, while the general public watched freely from open road sides.

The Americans had a different view. Entrepreneurs ran the cheapest available cars on artificial ovals floored with wooden boards that were already used for bicycle racing. The ovals were short and enclosed by tall wooden fences so that organisers could charge for entry into what was billed as pure entertainment.

From the start, the American motor race was an entertainment business. The racetrack was somewhere to corral people in order to sell them food, drink, souvenirs, insurance or whatever else seemed possible. Car manufacturers did add some sponsorship, but their approach was firmly 'race on Sunday, sell on Monday.' If there was any track-spawned technical development then little survived the bean-counting journey to US production tin tops, other perhaps than Bumble Bee stripes and glass fibre hood scoops.

One can still trace those two radically different starts to motorsport. European fans talk about technical advances and most are prepared to suffer some entertainment lulls for the technical interest and racing purity gained from a set of identical rules for each car. Americans, however, talk more about entertainment values and are prepared to emasculate technical advances and sporting 'fairness' for edge-of-seat family entertainment, complete with burgers, fries and autograph-signing drivers with big grins.

"Technical innovation and advance is a key component of any business"

It is common for US racing to enforce different rules for different cars, often at only a few hours notice, to keep performance as equal as possible at the finishing line. A pole-sitter finishing a minute out in front would likely signal national outrage in America, but receive a standing ovation in Europe.

The European system has arguably led to more technical innovation and to more of that innovation being applied to road cars. The American system seems to have spawned little, if anything, to improve their road cars and, if one stretches a point, it might be arguable that the lack of innovation in US motor racing was partially responsible for the decline of what were once the three biggest companies in the world – GM, Ford and Chrysler – now beaten hands down by clever little imports bristling with technical innovations, some of which were certainly developed within motorsport.

Apart from the rear view mirror, one can list drag reduction through aerodynamics, fuel injection, tyre life and grip development, active suspension and anti-lock braking systems, as well as ride and handling science. All of that appears to have been developed far more in Europe and made available on road cars at a time when American products were notorious for solid axle, leaf spring suspension, squealing tyre material, poor brakes, poor fuel economy and dreadful, almost undamped, ride and handling.

Technical innovation and advance is a key component of any business, and motorsport should not forget that. Pressure from marketing managers, public relations and media advisers to relegate our sport to a cash cow entertainment where paddock motorhomes house more innovation than the racecars must be held at bay or we could lose a technology-based business worth billions.

Europeans back technicial innovation; Americans prefer the show

Innovation nation

Can motorsport technology be relevant again?

The next few years in racing could be pretty interesting from a technical perspective. The last decade has seen big leaps in innovation stifled by regulatory bodies petrified of spiraling costs or, shock horror, teams gaining an unassailable advantage. However, it would seem that reality has bitten across the board, and racing at all levels is being left behind. Fortunately, the powers that be have woken up to this and it seems that technical innovation is back on the agenda as an important part of the racing mix.

Yes, racing action is important, with closely-fought battles between drivers a sure-fire winner as far as the fans are concerned. But, if this was the only thing that mattered, wouldn't every F3 race have a capacity crowd? Technology is undoubtedly still a big draw, both for fans and sponsors, and finally it is beginning to take centre stage again. We are not talking about the technology that allows McLaren to spend two days in the wind tunnel developing a tiny carbon vane that is of no relevance to anything else on the planet, but real technology that people can relate to and which, more to the point, is beneficial to other markets outside the closed loop of motorsport.

"Sportscar racing is still the home of real innovation"

The 2014 F1 regulations, though slightly watered down from the original concept, will produce engines that are far closer to those running in today's mainstream production cars – well, at least more so than 18,000rpm V8s. This can't help but appeal to the car manufacturers who, even the most ardent supporter of independent operations must admit, are still a major force in these cash-strapped times.

Clichéd as it may be, racing is like war, and both occupations accelerate technical development at a rate of knots. Engineers are in F1 because they like the challenge and good ones thrive in its high-pressure environment. And while refining an existing engine may be interesting, having a brand new one to develop is a whole different ball game. During a recent conversation with an engineer working on Mercedes' new powerplant, it became clear that although the project was a challenge, it was one the team relished. Give F1 teams the innovation ball and they are going to run with it.

The encouraging thing is that it is not just F1 embracing a drive towards road-relevant technology. In fact, the ACO rather got the jump on the FIA, with rules that actively encourage new technology.

When it unveiled a set of technical regulations that gave manufacturers free reign to develop a range of road car-relevant energy recovery systems, it was a clear signal that Sportscar racing is still the home of real innovation. By leaving the rules flexible enough to allow some free thinking, ideas have turned up that could have real benefits outside racing. Take for example the development of dampers that double as electrical generators, something the ACO has said it will allow. These are the sort of technologies that could see real-world applications, the development of which will be driven at a pace that only exists in the pressure cooker environment of motorsport.

To steal another clichéd phrase, the future does look bright. Provided that regulators stick to their guns and ignore calls from naysayers that say 'the engines will be too quiet' or 'no one cares what is under the skin'.

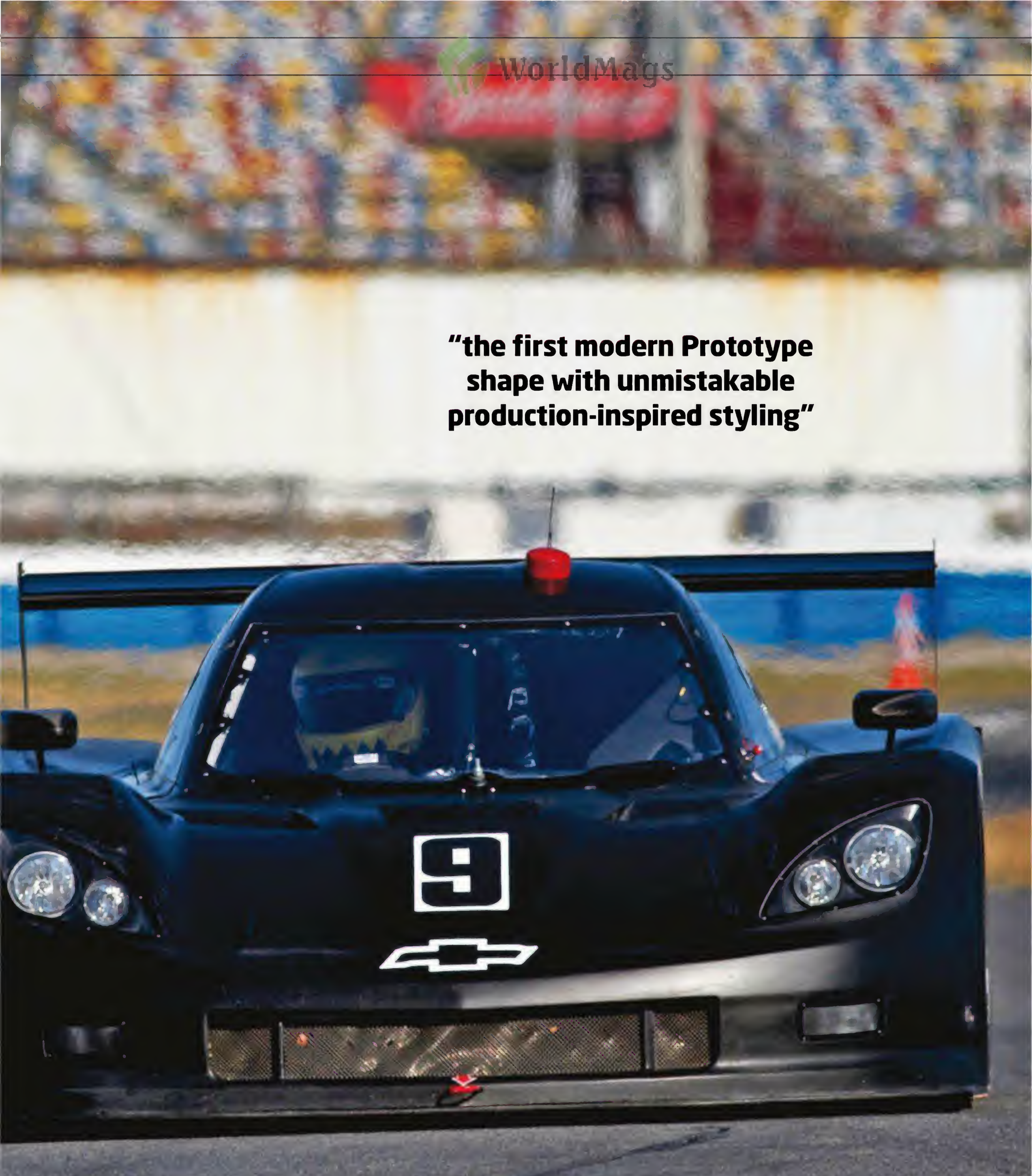
Motorsport looks set to once again assume its rightful place at the head of technological advancement.

Peugeot has stated that it needs a Hybrid programme to justify its racing expense, and bring relevance to its production cars. This is the 908 HYbrid4

It should happen to a 'Vette

The bold new direction Grand-Am is heading is being spearheaded, appropriately enough, by the most iconic American sports car of all

BY MARSHALL PRUETT



"the first modern Prototype shape with unmistakable production-inspired styling"

Take one look at the stunning new Corvette Daytona Prototype (DP) body and it's easy to appreciate the bold new direction the Grand-Am Rolex Series has presented its manufacturers. In a break from tradition, the series has crafted a new set of Prototype body regulations to give its factory engine providers the option to design DP 'shells that mirror the styling language of a road car. And, from a marketing standpoint, the move could help NASCAR's domestic Sportscar series steal the march from its FIA / ACO-based competition. Dig a bit deeper and we find the roots of the 2012 Corvette DP – created by GM Racing, together with its competition arm, Pratt & Miller – started life in 2007 as a feasibility study for the ACO's proposed 'LMP Evo' class. 'You could say a lot of the fundamentals, and pretty much the entire concept, really started back then with the idea that the ACO made some indication regarding rule changes to LMP [Le Mans Prototype]. They wanted to go back to more traditional-looking Sportscars and offer the potential element of product identity for the manufacturers that wanted to include that,'

Daytona Prototypes have received much bad press for their looks, but taking the stillborn Corvette LMP Evo concept into production might change all that

said Doug Louth, Pratt & Miller's director of engineering. 'That lined up with what Chevy Racing - GM Racing at the time - was interested in. They wanted to race either production-based vehicles or vehicles that are associated with and have conceptual transfer between racing and production.'

With the stillborn LMP Evo class forgotten, GM Racing found itself with an interesting mix of racing programmes. After more than a decade of success with its ALMS and Le Mans GT factory effort, the brand's core identity with ACO-based competition was intertwined with its production-based Corvette activities.

But building a bespoke Prototype to challenge the likes of Audi and Peugeot was never going to get the internal support, or the eight-figure budget required. However, with increased factory involvement in Grand-Am, specifically through providing its 5.0-litre LS7-based V8 engine, a cost-effective Prototype alternative began to emerge after a visit from Grand-Am founder, Jim France.

Having identified the need to beautify its 'visually challenged' DP body shapes for the 2012 season, the manufacturer and sanctioning body didn't need to look far for a solution. A more relevant body form already existed, the Corvette LMP Evo serving as a guideline for what was possible.

'Grand-Am, GM and Chevy liked the idea so much, and that interest coincided with discussions with Grand-Am on where they might go [in the future], and the next steps for Grand-Am and DP racing specifically,' said Louth. 'Concern over the image of the cars and product identity all kind of lined up with the concept for the Evo, and it made sense to Grand-Am. So the car really evolved from that. We then worked very closely with Grand-Am to flesh out the details.'

"all the primary body pieces are identical between all three chassis manufacturers"

With both parties working in concert, the first modern Prototype shape with unmistakable production-inspired styling was set in motion. Although the Corvette LMP Evo shape is very similar to the Corvette DP, Louth says it wasn't just a case of dusting off a five-year old design and sending it to the shop floor to be produced. 'A lot of the [LMP Evo] features are there, but the Corvette DP didn't originate from the same CAD files, or the same development work, or anything like that. The width and height and overall length are all different from that original proposal. It really was a clean sheet for what you see today.'

ENGINEERING CHALLENGES

Rather than mapping out plans to generate all-new Daytona Prototypes, discussions turned towards modifying the existing DPs manufactured by Coyote, Dallara and Riley Technologies to fit the series' desired styling cues. According to Louth, making fundamental changes to the greenhouse structure was the first engineering challenge.

'We worked with Grand-Am to come up with a body / rules package that could fit around the existing chassis structure. So, with the exception of modifying the rollcage to allow for a smaller greenhouse and working from helmet clearance and lines of sight needs, the body really was a clean sheet, but built around the existing DP chassis. In the end it served the same purpose [as] it meets a lot of the objectives the original Evo concept was going after.'

After taking over the manufacturing of the Coyote chassis last year, Pratt & Miller went into the Corvette DP project with a clear idea of what was required to fit the carbon fibre body on its own chassis, and quickly drew Dallara and Riley into the process to develop a standardised fitment routine. 'We all had to meet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140,000 CPU hours went into developing the body. Here a pressure map

the safety requirements of a smaller greenhouse and all the clearances and 'cage dimensions,' Louth continued. 'We received the CAD files of the Dallara chassis, and had a similar situation with Bob and Bill Riley. In the end, the bodywork was designed to fit not only the Coyote but the Dallara and Riley [chassis] as well. There's a few attachment parts that are different from car to car, but all the primary body pieces are identical between all three chassis manufacturers.'

In what could be described as the reverse of IndyCar's aero kit concept, GM Racing sought to bring a spec body to multiple chassis and, although the project received positive feedback, Pratt & Miller had to wait until the second quarter of 2011 for the go ahead to bring the Corvette DP to life. 'The concept of doing this was maybe 18 months old,' Louth said early last December. 'The conceptual designs for 'cage packages, greenhouse sizes, the design work needed to support the rules development, that all occurred from probably October of 2010, and continued all the way through to when the rules were finally finished on, I believe, April 6 [2011] or so. Prior to that, work was done but almost all of it was, I want to say, *ad hoc* conceptual stuff to support the regulations development. The real surfacing and design work that ended up as what we have today started, at the earliest, late March of last year. But really, when the rules were finalised, that was the 'go' point.

'And that was the decision point for Chevrolet. We had come up with a plan for manufacturing and supporting the teams and had estimated target test dates. We knew it was going to be a very short timeframe to actually have the cars on track, or in the wind tunnels, prior to Daytona 2012. So really, it took from April until [mid-November], pretty much eight months.'

VIRTUAL DESIGN

As is the case with all racecar development these days, virtual design and testing tools were used extensively throughout the process. Approximately 140,000 CPU hours were spent on the

THE RILEY TRACK DAY CAR

In 2009 Riley launched what, at first glance, was a re-styled Daytona Prototype for track day customers, but the MkXXII was a purpose-built machine. 'We started with the same concept, but pretty much everything is just for this car – the suspension, chassis, everything,' explains Ron McMahon, Riley Technology's vice president. 'The only parts that carried over were the wing mirrors.'

The original car was equipped with a 6.2-litre, 500bhp Chevrolet LS3. But, at the 2011 PRI show, Riley revealed a much more potent version, equipped with a new, 5.0-litre, BMW S85 V10, custom built by Dinan and producing 720bhp. 'This one was built to order for a customer who plans to use it at a country club track, but it is much faster than the Daytona Prototype,' enthuses McMahon. 'The guy just wanted to do something different, and go a lot faster. As a result, it has a lot of special options on it: it has a six-speed sequential Xtrac transmission in place of the usual EMCO; it has a special crash structure on the front; it has a full carbon fibre body, where a 'glass body comes as standard; and it has a MoTeC ECU rather than an OBR. Also there is no air conditioning. Finally, the aerodynamics are different, with a fair bit more downforce from the bi-plane rear wing and front dive planes. The guy has a special goal in mind, but we cannot yet disclose what that is.'

Whilst this car opens up a new performance bracket for the MkXXII, it is not a one off, all of the upgrades are available to other customers, at a price.

The revised Riley MkXXII features a new front impact structure and all carbon fibre bodywork

A Dinan-tuned 5.0-litre BMW engine gives this track day special 720bhp. It has been developed for a private customer, but all options are available

THE GENERIC RILEY BODY

The Corvette will not be the only third generation Daytona Prototype taking part in this year's Rolex 24. For those who want to utilise the new look cars but do not want to run with a GM powertrain, there is a generic body shape that has been developed by Riley Technologies but can be fitted to either the Coyote or Dallara chassis. Unlike the Corvette, the new body is not styled for any particular manufacturer, but negotiations were in place with OEMS to develop a third DPG3 aero kit. The first generic-bodied Riley is currently under construction at the firm's HQ in Mooresville, NC.

The generic Riley bodywork is designed to fit all third generation DP chassis, for teams who do not want to run Corvettes

The DPG3 chassis under construction at Riley Technologies. The lower section is the same as the DPG2, but the upper section is all new

overall body surface and detail items like cooling ducts, brake ducts, radiator through flow, engine air intake, the front under wing, the rear wing and engine bay airflow.

'The work horse is the in-house computational server at our corporate group in North Carolina, a wholly-owned subsidiary of Pratt & Miller. It is basically a privatised and further developed [Department of Defense] code, a Navy code,' explained Louth, 'that has been developed and optimised specifically for the types of problems we face in motorsports and OEM vehicles, and we use well beyond that. There's I think 3500 or 4500 processors in the supercomputer and that grows every few weeks. It seems like there's 500 more nodes, or something like that, every time I look… Beyond that, there's gridding software and surfacing software, and then post-processing. We use Field View for visualisation and interrogating work on the side-on portions of the car. So it was quite an effort. But in the end, compared to what you would normally do under a normal timeline on a new car like this, we really did a fraction of the work.'

Keeping GM, the series and the two other DP manufacturers engaged in the process, all while edging closer to a finished product was an important element for Pratt & Miller. 'It was a massive, coordinated undertaking. There was work going on simultaneously with CFD, aerodynamics development and with all of the wetted services. And at the same time we were meeting with, doing reviews and getting feedback from the production Corvette designer. It was a collaborative and productive relationship with the production side of the Corvette team. Those guys are invaluable and a lot of the things that are on the cars you see today are probably their ideas.'

Certainly, delivering a uniform

"a collaborative and productive relationship with the production side of the Corvette team"

the results and providing analysis. But then we also have a lot of our own analysis tools and custom codes for processing the data for different purposes.'

By relying heavily on these virtual tools, and their experience in using them, Pratt & Miller was able to handle the heavily compressed delivery schedule. 'It was a huge effort,' Louth confirmed. 'Everything. All the phases were overlapped, with concurrent engineering. Where we were still doing aero development, we started with the overall aero package - basic function - and then quickly moved to the cooling and braking function down front. The greenhouse was the first big area though, then we nailed down the front under wing and, as the interaction allowed, we were freezing portions of the car for detailed design and tooling design and manufacturing while we were still doing conceptual product is something that made Louth and all involved with the Corvette DP concept quite proud. 'All the Corvette bodies, regardless of what chassis they're on, are identical. All the wetted surfaces, all the important bits: ducts; front under wing; sidepods; rear deck; rear wing mounts are all identical. That is one of the objectives Grand-Am set. They wanted to balance a Corvette with a generic Riley Gen 3 body with a Gen 2 Dallara body, or whatever else. They want all the Corvettes to be the same. So when they were looking at adjustments for tuning devices or balance performance mechanisms, they can be applied across the board to all the Corvettes. That's an important part of this.'

Mechanically, the GM Racing team needed the three DP marques to make changes of varying difficulty to common areas. With the Coyote and Riley

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The nose shape of the Corvette bodywork caused a few headaches for Dallara who previously used a front-mounted 'snout-like' radiator

Teams took delivery of the DPG3 Corvettes ahead of the open test at Daytona in February. Performance on track was very close to expectations

As the new cars will compete with the old cars in the upcoming season, much work went into balancing the aero package between the two

DPs using wide, front-mount water radiators positioned at shallow angles, the Corvette nose and inlet / outlet ducting was a simple task to fit, compared to the Dallara, which has used a tall and narrow, snout-like radiator since its introduction to the class. The Italian firm was therefore forced to move away from its unique layout in favour of a shared solution. Beyond tailoring the cooling and ducting across the three chassis to fit the needs of the Corvette body and V8 engine, the other mechanical aspects of the cars went largely unchanged. Louth: 'The development between the chassis manufacturers is really relegated to mechanical suspension, dampers, springs and other related systems, but the body is pretty much fixed.'

While Grand-Am did not mandate specific aerodynamic targets for Pratt & Miller to hit with the Corvette DP, it did provide a close framework of what lift-to-drag (L/D) ratio to strive for, and ranges of downforce and drag to provide for its teams. 'We did a lot of work ahead of time and a lot of analysis working towards targets around where the current cars are at,' explained Louth. 'That was surprisingly effective considering the new cars are night and day different to last year's cars.'

COMPETITIVE BALANCE

With the Corvette DP body ready for testing and tuning, the series scheduled three 12-hour shifts at Windshear's full-scale facility in North Carolina, and multiple tests at Daytona International Speedway in the lead up to the 50th running of the 24 Hours of Daytona in 2012, and Louth says he is confident a competitive balance can be achieved before the landmark event. 'We're working with Grand-Am on various rules and aerodynamic elements to achieve aero performance targets that are as good or better than the current cars, with the understanding that in the first year there would be both new and old cars, and there would be a balancing process to make sure all cars can compete on a level playing field.

'We were in the wind tunnel with Grand-Am looking at aero balance mechanisms between the new and old cars. Our design engineers had a full kit of spoilers, front under wing insets, wickers, blockers, tunnel fillers and things like that, which we could apply to the car depending on what we found. When we finally got to the track, we saw the cars aren't that far apart, just a few miles an hour here and there.

'After the two days on track at Daytona we had a more complete understanding of the car that was at the tunnel test. And everybody kind of breathed a sigh of relief that the differences were in no way insurmountable, using relatively simple tuning devices or balance adjustment mechanisms. Whether it's mandatory wickers, wicker heights, maximum wing angle of attack or so on. It was a lot closer than I thought it might've been.'

Whether the arduous task of outfitting three different chassis with the Corvette DP body will pay off with a championship win in 2012 is unknown but, from a marketing standpoint, the relatively limited costs involved to generate a custom DP body - said to be between $750,000 (£481,000) to $2.5 million (£1,603,415) - makes GM's choice to green light the Corvette DP a winner as, with Ford and BMW sticking with its pre-existing plans to supply engines, it looks likely to have the next generation body market to itself for the coming year. For all of the engineering resources it required and races it might win, it's hard to deny that in the performance category that matters most to US car manufacturers, the Corvette DP has a firm lead over its rivals in the race to the showroom floor.

"GM looks likely to have the next generation body market to itself for 2012"

TECH SPEC

Daytona Prototype Generation 3

Chassis: tubular frame by Dallara, Coyote or Riley Technologies

Wheelbase: 108-110in

Suspension: double wishbone with pushrod-actuated dampers

Steering: power-assisted rack and pinion

Transmission: Xtrac 386 or EMCO six-speed sequential (five-speed if using a 5.0-litre V8)

Brakes: maximum of six-piston calipers, multiple manufacturers

Engines: six or eight cylinders, fuel-injected engines from GM, Lexus, BMW, Porsche (two options), Ford, Infiniti and Honda. All approx 500bhp, maximum 5.0-litres

Fuel capacity: 24 US gallons

Weight: 4.0-litre and above: 1032kg
Up to 4.0-litres: 1010kg

Cost: $400,000-$500,000

Shooting for the stars

Daytona Prototype meets Japanese GT300, as aerodynamic design and bodywork specialist, Mooncraft, develops a whole new concept

BY SAM COLLINS

When Japanese racecar manufacturer, Mooncraft, decided to enter the Super GT series, it was never going to be a simple case of adapting an existing production car into a high performance competition vehicle. The company, founded in 1976, has a long history of developing bespoke racecars, with its first competition cars appearing in the early 1980s.

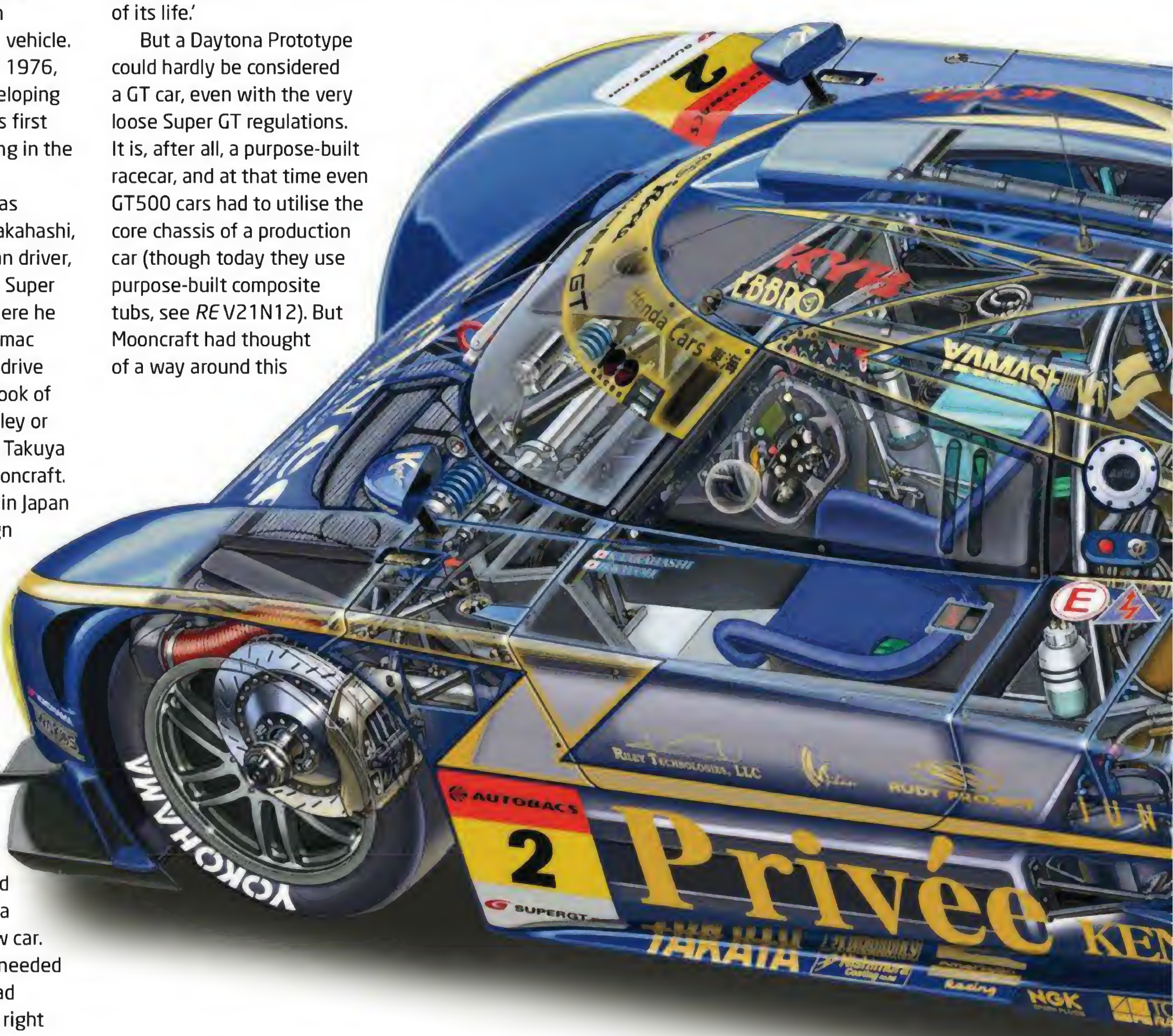
In 2005, Mooncraft was approached by Kazuho Takahashi, an enthusiastic gentleman driver, about producing a car for Super GT's GT300 category, where he already campaigned a Vemac Sportscar. 'He wanted to drive something that had the look of a Le Mans car, like a Bentley or Toyota GT-ONE,' explains Takuya Yura, the president of Mooncraft. Yura's firm is well known in Japan for its aerodynamic design and bodywork development capability, which currently are used by a wide range of constructors, including B-Max and Tokyo R&D for their F4 projects.

But the company is not so well known for chassis development and construction, so for this project Yura's engineering team decided to look outside Japan for a suitable basis for the new car.

'With the chassis, we needed to find something that had real reliability, and at the right cost. By 2006, many Daytona Prototypes had been built and they were all shown to be very strong. Also the cost of their bare rolling chassis were not that high,' reveals Yura. 'The reliability of this car is very good -this is the sixth year it has run, which is way beyond their estimation of its life.'

But a Daytona Prototype could hardly be considered a GT car, even with the very loose Super GT regulations. It is, after all, a purpose-built racecar, and at that time even GT500 cars had to utilise the core chassis of a production car (though today they use purpose-built composite tubs, see *RE* V21N12). But Mooncraft had thought of a way around this problem – it would create a very limited run of 'production cars', just as Takahashi's Vemac, which had been allowed to compete in GT300 for some time.

'At the time, Super GT technical regulations said that the car must be based on a commercially available series production car,' explains Yura. 'So we had planned to get a Daytona Prototype chassis, make our own bodywork and then register it for the road, so we could take part in the series. A bit like what Toyota and Nissan did with GT1 in the



The Mooncraft team was spoiled for choice when it came to selecting the running gear, but the Riley Mk XXII proved to be the most suitable for the driver combination

late 1990s, where there was not really a commercially available road car. But the then secretary general of GTA, the governing body of Super GT, said that it was no problem and that we did not have to make a road car.'

CHASSIS CONUNDRUM

With the path clear for Mooncraft to convert an existing Grand-Am chassis into a GT300 car, the next question was which chassis to choose as, in 2006, a number of chassis manufacturers came to the market.

'To decide which chassis to use we went to Daytona to choose the best handling car for our gentleman driver. That proved to be the Riley Mk XXII.'

With the chassis decided, the team turned its attention to the powerplant. To keep things simple, and to conserve the Riley's handling and weight distribution, the choice was restricted to those powerplants already utilised in Grand Am. 'There was a range of engine choices and we chose the Lexus engine because it Japanese, of course!' smiles Yura. 'We had to modify the engine to take part in Super GT so it's not completely the same as a Daytona Prototype engine. The intake was made in house and, whilst the Daytona Prototype engine only has four butterflies, ours has one per cylinder. Also, to fit the Japanese specification for these races, we have a lot less power than a Daytona Prototype, because the restrictors are very small.' This resulted in an output of around 350bhp for the engine in original trim, around 150bhp down on the versions used in the American series, though over the years the performance of the 4.4-litre V8 has been pegged back.

'We also decided to carry over most of the suspension from the Daytona Prototype. We chose this chassis for its handling, so why change it?' says Yura. The six-speed sequential Xtrac transmission used by Riley was also carried over.

After all the key components had been decided, Riley Technologies developed a revised version of the Mk XXII at its new headquarters in Mooresville, NC. As is the case with the new third generation Daytona Prototype, the new chassis featured a standard Mk XXII lower chassis, but with a much narrower and lower 'greenhouse'. The rolling chassis was then supplied to Mooncraft in Japan without a body. Yura's team then set about developing a bespoke body for the car which, when it was first rolled out on track, drew admiring looks from all who saw it. But the body did more than look pretty. It was the absolute focus for Mooncraft's engineers.

'I couldn't say how this car would compare with a Riley because it is not polite to Riley!' enthuses Yura. 'The Daytona Prototype regulations have many restrictions about the aerodynamics, particularly cockpit

"We chose the [Riley Mk XXII] chassis for its handling, so why change it?"

Sadly, this car will never race at Daytona as Mooncraft is now busying itself turning the MC/RT-16 into a road car

Styling was designed to capture the essence of a professional Le Mans car, and the styling cues from the Toyota entry are clear to see throughout

TECH SPEC

Car: Mooncraft MC/RT -16 'Shiden'

Class: GT300

Chassis: modified Riley Mk XXII Daytona Prototype tubular chassis

Engine: Toda Racing / Toyota 1UZ-FE 4.4 litre N/A V8.

Restrictor: 2x 23.6mm

Performance: 300bhp at 5300rpm; 38kg-m at 4800rpm

Transmission: Xtrac six-speed sequential, Tilton triple-plate clutch

Suspension: pushrod-actuated, double wishbone

Brakes: Alcon

Tyres: Yokohama 280/710-R18

Wheels: American Racing 11J-18

Wheelbase: 2790mm

Front Track: 1630mm

Rear Track: 1625mm

Length: 4675mm

Width: 1995mm

Height: 1110mm

Weight: 1225kg

size and the windshield. The greenhouse was very square on the Daytona Prototype so, from an aerodynamic perspective, our car is a lot better.'

As is common with Japanese competition cars, aesthetics played a key role. The car had to look right, and have that all-important Le Mans-type styling. However, it also had to be a competitive racecar, and to do that it was not simply a case of producing the best body shape possible from an aerodynamic perspective alone.

'We have two drivers in our team. One of them is a professional and the other is a gentleman driver. That means that the car would have to be very easy to drive,' explains Yura. 'Initially, during the car's aerodynamic development we had to go after all the good performance we could get, but we soon realised that the car should not be really peaky to drive. We did not want the car to have a very narrow window of operation, and if we had chased the ultimate aerodynamic performance it was likely to have made the car quite pitch sensitive and not easy to control. As we had a gentleman driver, it had to be very driveable and stable. So, as a result, we did not do a lot of wind tunnel development on it and focussed instead on stability.'

VIOLENT LIGHTNING

The result of all of this work was the MC/RT-16, as the car is officially named, MC for Mooncraft, RT for Riley Technologies, but everyone simply knew it by its nickname, 'Shiden', Japanese for violent lightning. Visually, there was almost nothing of the Daytona Prototype left – the new bubble-like greenhouse suited the swoopy lower body from an aesthetic perspective and, from a dynamic point of view, the drivers commented on how easy it made the car to drive.

From its first race in 2006 the Shiden was competitive, claiming second in the teams' championship in its debut season and going one better the year after. It beat off a mix of JAF GT300 cars and FIA GT3 cars as well as other one-off specials, such as the Arta Gairaya. But its roots as a purpose-built car saw it hit with many 'performance adjustments.' At the end of 2006 it was given an additional 100kg on its minimum weight, and a further 25kg the following year, compared to the 1200kg of the Lexus IS350 running in the same class. The twin restrictors on the Toyota V8 were also cut in size from an already tight 24.3mm down to a suffocating 23.6mm. The GT300 Lexus IS350, which utilises the Toyota LMP1 engine, has twin 30.6mm restrictors.

ONE OF A KIND

Despite its strong form, and perhaps as a result of the controversy it attracted, the Shiden was only ever a one off. 'We would have made more, but nobody wanted one. It is as simple as that,' admits Yura. Until the end of 2011 season every year the organisers added additional restrictions to the car until it was eventually outlawed at the end of the 2011 season.

That aside, Mooncraft had shown that Daytona Prototypes did not have to look so ugly after all, and perhaps Mark Raffauf and the team at NASCAR R and D took note of the Mooncraft, with its conventional DP chassis but revised greenhouse and attractive bodywork, when they were working on the DP-G3 concept.

Whilst it would have been fantastic to have seen the Shiden returning to its spiritual home on the high banks at Daytona after its enforced retirement from Super GT, it will unfortunately never happen. Instead, Yura's team at Mooncraft are now undertaking the task they set out to do in the first place, and are turning the MC/RT-16 into a road car. So, if later this year you are driving in the area around Shizuoka, Japan, you might just get a glimpse of a Daytona Prototype in your rear view mirror as you pop down to Newdays to buy your instant noodles!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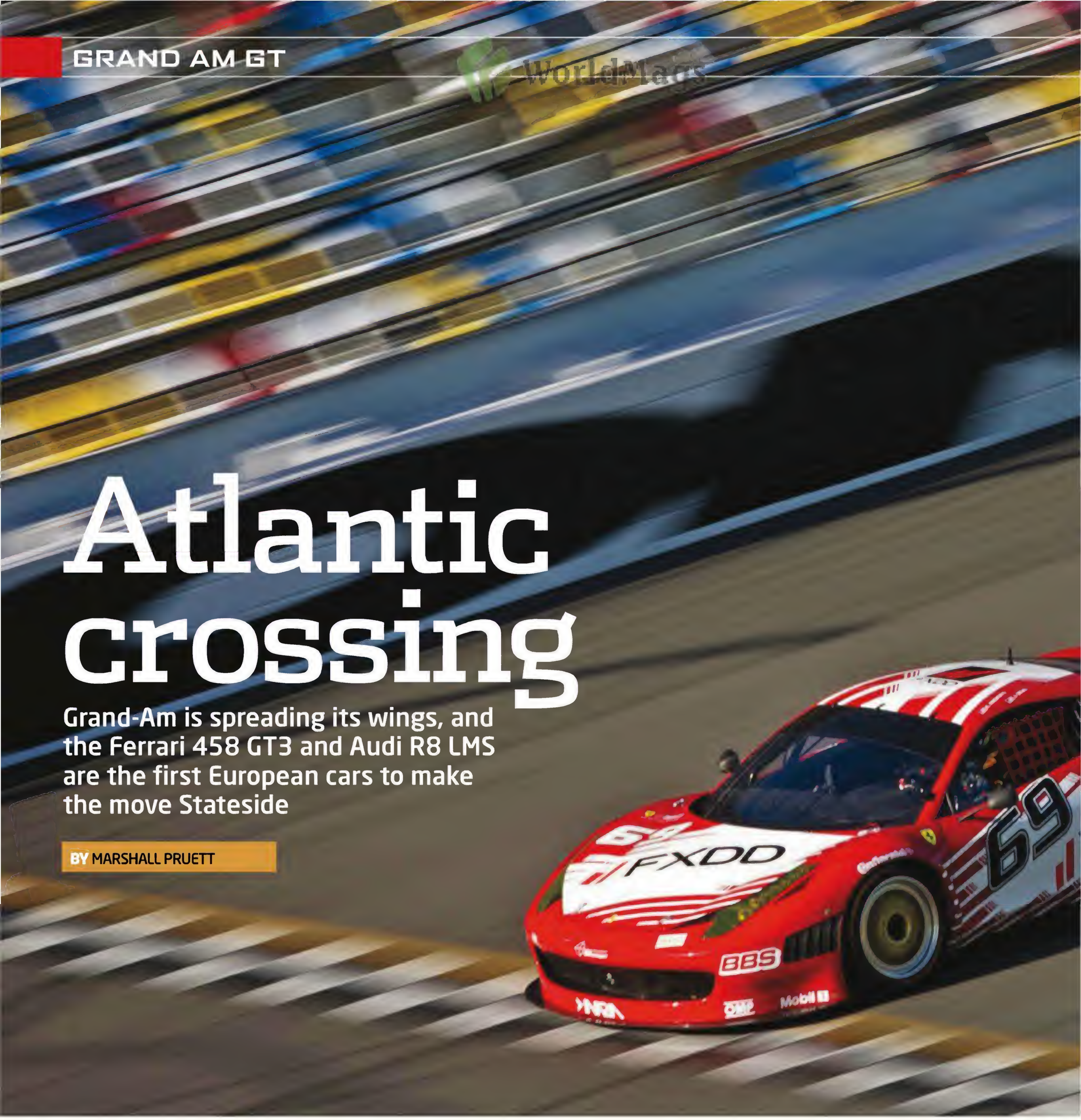


Atlantic crossing

Grand-Am is spreading its wings, and the Ferrari 458 GT3 and Audi R8 LMS are the first European cars to make the move Stateside

BY MARSHALL PRUETT

Faced with the need to add new lifeblood to its GT ranks, the Grand-Am Rolex Series courted two of the two most established GT3 manufacturers to add a European flair to NASCAR's domestic Sportscar series.

Working with Ferrari through its Michelotto arm, and Audi with full engagement from its Customer Sport division, Grand-Am managing director of competition, Mark Raffauf, says plans have been in place for some time to adopt more conservative GT3 machinery.

'We told Ferrari back in '05 and '06 that when you build the [F430 replacement], please let us know and let us be part of the process from the beginning,' he said. 'That way a better business model can be made for you as a manufacturer for a customer programme. You don't have to build something and then change it, you build it with what we'd be looking for at that time from the beginning and it could fit more than one set of regulations without too much work.'

With Eddie Cheever, former F1 driver and owner of the Coyote Daytona Prototype marque, acting as a liaison between the series and Ferrari during the F458's conceptual stages, a Grand-Am-specific version of the F458 GT3 was finalised as Michelotto worked through its production fulfillment.

'They built the basic GT3 cars first - about 30 of those - because there was a higher demand for them, and then all the Challenge cars. There were about 150 of those,' says Raffauf. 'Sure enough, they got to ours and, by July of this year, the first one was over here and testing at Daytona.

'All was good. The engine came to our dyno, we did all the testing and quantifying that we do for everybody else. They had incorporated all the changes

Main picture: Grand Am has opened its GT doors to allow in more European manufacturers, including the GT3-based Ferrari, which had Grand Am in mind from conception, while the Audi has been adapted to Grand Am specification

we requested and I think they originally planned to build three a year, maybe four, which they've already sold. I think now there's a fifth one in the works.'

In a class filled with a mix of spaceframe and production-based GT cars built to a bespoke Grand-Am specification, only Porsche's venerable 911 GT3 Cup cars came into the series with a familiar international standard, prior to the adaptation of the F458 and R8 LMS.

"The primary differences from GT3 has always been the rollcages"

Starting from an agreed upon list of GT3-to-Grand-Am conversion items, both manufacturers went about their Rolex GT workload with the possibility of converting the F458 and R8 LMS back to Euro-spec GT3 if so desired.

'The biggest changes are in three areas,' Raffauf continues. 'The primary difference from GT3 has always been the rollcages. Our 'cages use a similar diameter tube, but thicker walls, and require more bars than the FIA requires. They built the 'cages to our spec, which means they will work if the cars go back and race in Europe.

'Next, aerodynamics... that would be standardisation to *our* standard of aerodynamics, which is a Grand-Am spec wing, flat front splitter, plus certain vents and louvre exercises in the front end for adding downforce being closed off. A lot of what we called for was just adopting some of what we use already.

'GT3 cars already come with everything well defined so, for Grand-Am, it's a case of, 'call Max Crawford in North Carolina and order a wing. Modify your mounting struts so it fits the spread of the mounting points on the wing.' Those types of requests. The aerodynamic was easy, bolt on, just the way we want it.'

ENGINE COMPLIANCE

With Audi and Ferrari incorporating Grand-Am's unique rollcage requirements and dressing the cars with a blend of add-on components and dedicated aerodynamic parts, bringing the power produced by the R8's 5.2-litre V10 and the F458's 4.5-litre V8 into compliance with the Mazda RX-8s and Chevrolet Camaros that populate the class was a must.

'We looked at where we thought the GT3 power levels would be and made a theoretical power curve for our class. Sort of a model power [and] torque curve. Our aim is to keep GT

The Ferrari 458 features a rollcage that is more robust than that required by the FIA, and so is suitable for both markets with only limited adaptation

levels around 450-500bhp, so that meant some reductions were needed. We looked at the Ferrari, figured out that the gap between torque and power was a little too big – it's a high revving engine [8000rpm] so it makes good power but, at 4.5-litres, it doesn't make a lot of torque. So we came up with a specification that they agreed was sensible and that's what they built. When they brought it to the dyno it was spot on.'

With the F458 so new to the world of racing, Grand-Am has given Ferrari teams options for its Rolex GT racer that, to date, have not been afforded to the battle-tested R8 LMS. Raffauf: 'We've given Ferrari some freedom, particularly with the springs and gear ratios and things like that. In GT3, you pretty much use the ratios and the springs you want, or are needed, on a variety of tracks. We only give them the option of two homologated sets of gear ratios and springs. That's pretty much it.'

ADD, THEN SUBTRACT

With all of the aforementioned additions to Grand-Am's new GT3-spec cars, the greatest changes to the platform are to be found with the subtractions that were required for it to compete in Rolex GT competition.

'Our new GT3 manufacturers took out all the street driver aids. Those are part of the European GT3 spec, but our GT cars don't use them. There's no traction control, no ABS, none of that stuff. The systems designed for the street don't really work on the racetrack. And the cost of doing racing versions of some of that stuff… it's too stupid, even for GT3. Some of them have production systems in there but they're not as effective as they could be.'

Although many GT3 manufacturers would undoubtedly debate Raffauf's opinion on how suitable those electronic systems work in the Euro versions of both models, Grand-Am's firm stance on the topic means that current and future GT3 marques will all be required to make the same modifications.

Tasked with the same build requirements as Michelotto, Romolo Liebchen, Audi's head of Customer Sport, had the benefit of starting with the proven, championship-winning R8 LMS to transform into what it calls the 'R8 Grand-Am'.

'From outside, we did what we thought was reasonable. We had to change the aerodynamic components like the splitter, the diffuser and the rear wing. The rest of the body is from what we already have. The diffuser was modified to reach the shape, which is now quite similar to the road car shape. The splitter was then modified to work with the new diffuser, which has less diffusion than the [standard] GT3 version.'

"We had to change the aerodynamic components like the splitter, the diffuser and the rear wing"

However, not wanting to miss an opportunity, Audi went to great lengths to make sure the Grand-Am version of the R8 could also be quickly converted to race in other championships.

'In principle, everything can be changed back, with the only exception being the rollcage. We had to modify some tubes from 1.5mm up to 2mm, so we have now a special rollcage for Grand-Am and generally, while no European GT3 car can come to Grand-Am without the changes, the R8 Grand-Am can go the other way around.

'We made things quite simple in other ways too, so we stayed with ABS and kept the electronic unit in the car, only modifying the housing for the brake system so no brake lines go to the ABS module, but instead go directly to the caliper. So, in principle, it's quite easy to make the change back to working ABS in the car. Same with traction control. This was the reason we had to remove the rear wheel speed sensors, but those are very easy to put back.'

Surprisingly, despite lacking the assistance ABS provided the GT3 version of the car, Audi was able to retain the same brake package from the R8 LMS.

Although Grand-Am does not traditionally publish the restrictor sizes it mandates for each model, Audi, like Ferrari, will have a few

Audi has turned to one of its former LMP1 engineers, Brad Kettler, to organise a soft introduction into Grand Am with the Audi R8. The plan is to build a maximum of four cars, regardless of demand, and build the support network

options to choose from until the series strikes the competitive balance it desires.

'We had to reduce the power a lot, and had to make a new database for Grand-Am so [the engine] would be roughly around 450bhp,' said Liebchen of the big V10 that revs to 8600rpm. 'With different restrictor sizes, we can adjust the power from 450 up to 500[bhp] without any modification on the ECU. There's no electronic work to do on the car [to achieve that].'

Compared to some of the used Rolex GT cars that trade at roughly half the price of a new Grand-Am-spec GT3 car, the R8, as Liebchen shares, provides cost savings in other areas to help justify the higher purchase price: 'At the moment, our proposal is to make the big engine rebuild after 20,000kms, but we have an engine that has run for more than 30,000kms now. It is really one of our biggest advantages - the mileage and the running cost of the engine. I think they are the lowest you can find. I can give you an example with what we did this year with our factory cars - we raced in the VLN [at the Nürburgring] ahead of the Nürburgring 24 Hours, then we tested at Spa, competed in the Spa 24 Hours, brought the cars to

The Audi V10 revs to 8600rpm, but had to be de-tuned via the ECU to 450bhp. Now, using restrictors, it can be altered between 450 and 500bhp

Sepang and also competed in the six hours at Zhuhai. Same engine. No rebuilds. We like that you buy this racecar and can forget about things like this.'

CUSTOMER SUPPORT

Although Ferrari has a well-established sales and support network for its customer racecars in North America, Liebchen and his Audi counterparts will need to create a new programme for its R8 Grand-Am clients. Indiana-based Brad Kettler, who continues to serve as one of Audi Sport's LMP1 engineers, will spearhead that new support initiative through his Kettler Motor Werks outfit.

Audi's soft introduction into Grand-Am for 2012 was intentional, according to Liebchen, as the manufacturer set modest goals for the marketplace while it builds its new GT support infrastructure with Kettler. 'I told everybody that we will build four cars and that's what we are doing, even if there is more customer interest,' explains Liebchen. 'We've reached that number now. Selling cars is one point, but you also have to get the support, and this is also what we have built up with Brad in America. More cars becomes more difficult to support, so we committed to a maximum four cars for this year, at least into the middle of the season. If everything is working fine with the customer support business and everything is working fine [with the cars] then we can think about bringing another one or two cars. The first thing, though, is to stabilise the situation on every point. That's the idea behind this.'

"The European cars have all the driver aids. Ours don't"

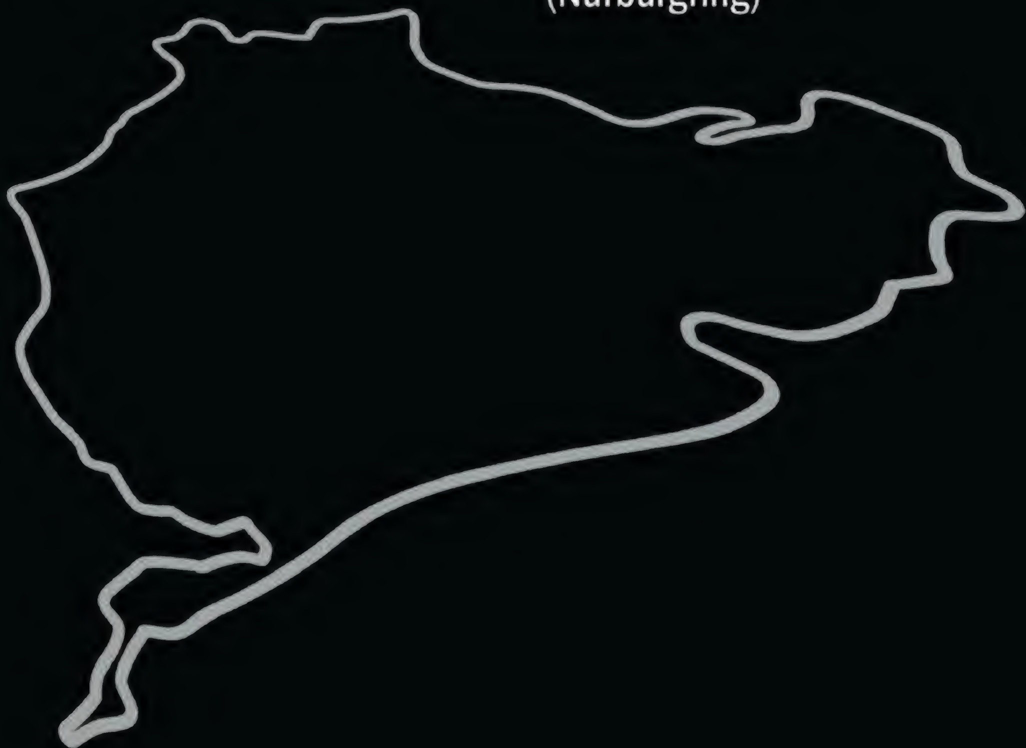
FURTHER INTEREST

While Michelotto and Audi continue to work on becoming major players in Grand-Am, Raffauf ended the conversation by confirming rumours of a few more GT3 manufacturers that could be seen Stateside in the near future: 'We've talked to Mercedes and we've got a running dialogue with Lotus on the Evora. We've also had a good dialogue with BMW on their Z4, and are also all set to dialogue with Reiter, who do the Lamborghinis, which use the same engines as Audi. The [Mercedes] SLS GT3 is a bigger technical problem because the car is heavy, really heavy, [though] it's got a lot of power. We have a bit of an issue with the fact that we run at Daytona and Homestead and require a very specific kind of tyre, which has a very specific maximum load. To get that power evenly reduced with the weight could be kind of close to the edge of where we are. We aren't really interested in developing structurally a whole different tyre to hold up a heavier car in the banking there.

'I think there's a practical limit to how many customers you can expect to have, but having new models for people to get involved allows some people with manufacturer alliances to move up. We loved the new McLaren too, but we've always said that once we start getting into composite GT chassis, that's where we draw the line. I'd look at the R8 and F458 and say those are the kinds of cars we could see more of in the future...'

ITS NO SECRET THE GERMANS HAVE SOMETHING WE ENVY...

(Nürburgring)



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Lessons learnt

The low-drag Lola T260 had all the ingredients to be a winner but, plagued by handling and reliability issues, it struggled to fulfil its promise

In their time the cars that competed in the CanAm series were the most powerful road racing machines in the world. By 1971 the leading CanAm teams were using engines with displacements of more than 8.0-litres and generating peak power outputs in excess of 750bhp, with peak torque of over 650ft.lb.

For its 1971 CanAm programme, Lola Cars looked for a technical advantage that would allow it to leapfrog the McLaren team that had dominated the lucrative North American-based Sportscar series for the previous four years. The result was the Lola T260, a car based on low drag aerodynamic principles intended to give it a straight-line speed advantage without compromising its cornering capability.

DESIGN AND DEVELOPMENT

Lola's chief engineer in 1971 was Bob Marston, and he played a key role in the design and development of the new car, working closely with company founder and chief designer, Eric Broadley. The body shape concept for the T260 featured a short, rounded nose and abruptly truncated tail, with a stark, straight upper bodyline connecting the two. The low-drag approach was evident by the use of a minimal front splitter, while a full-width wing positioned just behind the engine intake stacks carried no end plates.

A 25 per cent scale model of the T260 was soon testing down the street from the Lola factory at the Special Mouldings' wind tunnel, where Peter Wright was the in-house aerodynamicist. 'The small front splitter formed a lip around the leading edge of the nose, but it was quite localised and didn't really extend back more than a few inches,' recalls Marston. 'It wasn't as effective as we had hoped because the wind tunnel tests showed that high pressure built up on the front of the chassis under the nose panel. So we came up with a plan to use the low-pressure area on the upper surface of the nose to pull the high pressure air out through ventilation holes and generate downforce at the stagnation point on the edge of the splitter and nose.'

BY ALAN LIS

Further tunnel tests showed the ventilation holes to be worth pursuing, and they were incorporated into the full scale car. 'Of course, a wind tunnel only gives you answers to the questions that you ask,' says Marston, 'and in this case we didn't know what were the right questions to ask. What a wind tunnel can't tell you is how much downforce you can put on the tyres and how much downforce you need.

'Like all motor racing wind tunnels at that time, Specialised Mouldings' wind tunnel didn't have a rolling road and that's a big factor when you are running a car close to the ground. We now know that is very important but, at that time, we didn't have the experience necessary to realise. Like everyone in that era, we

Main picture: the perforated nose panel was a key element of the original low drag aerodynamic package. However, it proved to be far less effective on track than it had been in the wind tunnel

"a wind tunnel only gives you answers to the questions that you ask"

"a straight-line speed advantage without compromising its cornering capability"

The final attempt to increase frontal downforce saw this boom-mounted front wing added for the '71 finale at Riverside. Note 15in front wheels

The T260 raced on in 1972 in private hands and was still competing when the CanAm series folded in 1974

In 1972, the replacement for the T260 Lola CanAm racecar was the high downforce T310. The low drag experiment was now just a distant memory

were breaking new ground in racecar aerodynamics so didn't have past experience to call on. And of course, cars weren't instrumented in the way they are nowadays, so it was virtually impossible to quantify your results. That meant it was quite easy to be misled by wind tunnel results and then get a rude awakening when you tested at full scale on an actual car.'

"a worrying combination of front-end understeer and a lack of rear-end grip"

RUDE AWAKENING

Just such a rude awakening came at the opening round of the CanAm series at Mosport. Before it was shipped to Canada, the T260 had completed just a single day of testing at Silverstone where it had been shaken down by Frank Gardner, after which Jackie Stewart, who was to race the car in the CanAm series, drove it for a few exploratory laps in the rain. In a private test session at Mosport, Stewart was able to run the T260 in dry conditions and found the handling not to his liking – a worrying combination of front-end understeer and a lack of rear-end grip.

'In comparison to the cars he was used to driving in Formula 1, the T260 would have felt like that,' says Marston. 'Compared to F1, a CanAm car was big and bulky and rolled in the corners. It was a hell of a different car.'

Despite these apparent handling shortcomings, in the opening two rounds of the 1971 CanAm series, the T260 took pole position at Mosport and led the race until a transmission oil leak stopped the car. At St Jovite, Stewart managed to safely land the T260 when its nose lifted on a brow and was able to capitalise when the leading McLaren driver slowed due to illness, and the Scot won the race.

For round three, at Road Atlanta, the T260's understeer was addressed by the fitting of dive planes on the front wheelarches, and the downforce they generated was balanced by moving the previously centrally-mounted wing further rearwards. Stewart was again able to lead the McLarens in the race before retiring with a rear suspension failure. Before this, though, the effectiveness of the dive planes had been demonstrated when the right front tyre wore through the bodywork above. At Watkins Glen, Stewart led again and, at 194mph, was the fastest through the speed trap, 10mph quicker than the best of the factory McLarens, but the car succumbed to one of the numerous engine failures that blighted the T260's campaign.

ENGINE PROBLEMS

'Most of the engine problems we suffered that year were invariably the result of using an aluminium cylinder block with iron liners,' recalls Marston. 'I can vividly remember that often after the car had done the first practice session without a problem and the engine had cooled off, perhaps even overnight, within a few laps of starting the next session it would be in the pits with a blown head gasket because a couple of the liners had dropped.'

A month later, at Mid-Ohio, the T260 sported a revised nose section, which gave greater front wheel clearance. Initially, the T260 had been designed to run on 13in diameter front wheels, in the interest of minimised frontal area, but these had been swapped to taller 15in rims by the Atlanta race. In the race Stewart, concerned at the circuit's safety standards, drove conservatively and won when the McLarens hit trouble. Next time out, on the long straights of Elkhart Lake, where the low-drag Lola ought to have been in its element, fins were fitted on the tail to channel air toward the rear wing and form end plates and a larger splitter was also tried during qualifying but was discarded for the race. But once again, engine issues ended its race. For the race at

TECH SPEC

Engine: 8.1-litre (495ci) Chevrolet LS-1 V8; aluminium cylinder block and heads; cast iron liners

Chassis: sheet aluminium, full-length monocoque

Bodywork: glass fibre mouldings

Cooling: side-mounted water radiators; side-mounted engine oil radiators; rear-mounted transmission oil radiator

Front suspension: rocker arms with horizontally and laterally-mounted concentric coil springs and dampers; adjustable anti-roll bar

Rear suspension: reversed lower wishbone; single top links and radius arms; concentric coil springs and dampers; adjustable anti-roll bar

Dampers: Bilstein two-way adjustable

Transmission: Hewland LG600 six-speed

Brakes: cast iron discs, outboard mounted at front, inboard at rear

Fuel capacity: 65 US gallons

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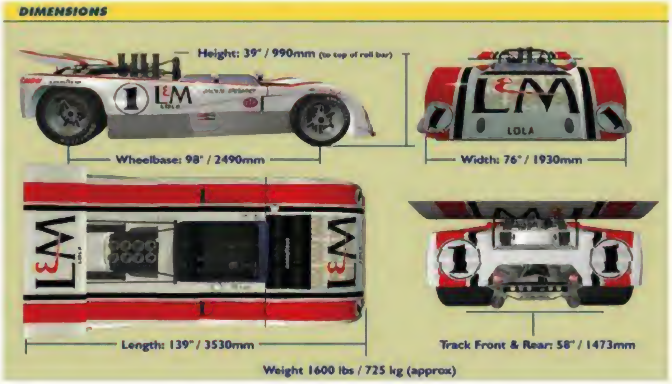
Donnybrooke, the T260 was reset to the Road Atlanta / Watkins Glen aero configuration after the taller front wheelarches were found to add too much drag and to partially obscure flow into the radiator inlets. Stewart again forced his way into the lead, only for a puncture to ruin his race.

AERO UPDATE

For round eight at Edmonton, Broadley and Marston swapped duties, Marston returning to the UK to start work on Lola's 1972 customer car designs, while Broadley came out to Canada with a major aerodynamic update for the T260. At the rear, the wing was repositioned overhanging the tail on twin tubular supports and a new shovel-shaped nose fitted. Abandoning the low-drag approach, this aimed at generating downforce by means of an aerofoil section on the underside and a central duct. Initially, the new nose was run unadorned but, by the race, additional side plates had been added to it in the search for further downforce. Stewart was slightly closer to the McLarens in qualifying and looked set to win the rain-affected race, until he first collided with a back marker and then later spun out, due to handling problems.



The T260 in its interim aero configuration with nose dive planes, raised front wheelarches and a further rearward wing

By the time of the race at Laguna Seca three weeks later, the T260 had undergone a further major transformation. The Edmonton ducted nose had been replaced with the original rounded nose, ahead of which was mounted an out-rigged, end-plated front wing of similar dimensions to that at the rear, as Broadley sought to pile on front-end downforce. The rear wing angle was increased to balance the car, but the Lola's handling still wasn't to the drivers' liking. Nevertheless, Stewart appeared to have won the race until one of the McLarens was reinstated as the winner, despite ignoring a black flag.

For the 1971 series finale, the T260 again ran the out-rigged front wing, this time matched with an end-plated rear wing. Even in this maximum downforce configuration, the Lola ended up nearly three seconds slower than the pole-sitting McLaren. A hard-charging Stewart was running in second place in the race when a piston failure brought his frustrating campaign to an end. Perhaps unsurprisingly, three days later it was announced that Stewart would drive for McLaren in the 1972 CanAm series. If you can't beat them...

A 2011 REAPPRAISAL

Low drag was the priority with the T260 and, in retrospect, it was definitely the wrong approach,' says Bob Marston. 'Our thinking at that time was that you couldn't beat reduced frontal area if you were looking to cut down drag, so at first we ran the T260 with smaller than usual front wheels. Shadow took that idea to the extreme with their 1970 CanAm car and, in most aspects, it didn't work at all but we felt our initial approach with the T260 was a sort of halfway measure. Of course, McLaren went the other way and wiped the floor with us...

'Thinking about the T260 now, we had a huge amount of horsepower and we really should have capitalised on that to generate a lot of downforce, and hence cornering power. Instead, we thought we'd try the straight-line speed approach, but I suppose you have to bear in mind that in those days there was less appreciation of the relationship between aerodynamics and car performance.

'When the car didn't work as we expected, it took time to realise what was our problem. Eventually, we did come to the conclusion that we needed front-end downforce and made changes to the nose. An admission of defeat, if you like, but you have to do whatever it takes to get the job done. The dive planes we tried first wouldn't have been a wind tunnel development because we didn't do any further wind tunnel testing after car went to America. In those days any wind tunnel tests were done only at the beginning of a project. Many other Sportscars had previously used dive planes and similar devices before we put them on the T260. After it became clear to us that we needed more front-end downforce, the dive planes were a quick way of addressing that.

'Eric's Edmonton nose design was an exercise in thinking on your feet, because by then it had occurred to us that we needed a lot more front-end downforce than adding dive planes and front splitter extensions to the original nose were ever going to give us. From what I recall, they found it was better than the original nose, but it still wasn't the answer to the problem. So, at the next race at Laguna Seca, the big front wing was added, which was another 'Eric-ism'. It was really a case of realising that nothing had worked well enough up to then and wondering what the hell could we do next, and reasoning that sticking a damn great wing on the nose was guaranteed to have some effect. Deciding how far the front wing was ahead of the nose and how far the rear wing overhung the tail was done by experience and intuition. That's how you worked in those days.

"in those days there was less appreciation of the relationship between aerodynamics and car performance"

'Given time, there would have been adjustment built into the wings, and there would have been a nice little test day somewhere to optimise everything, but there never was that sort of time available. The CanAm schedule was very tight, mainly because travelling and transporting the car and equipment from race to race took so long, it didn't really matter what good ideas you had during the series as you just didn't have the time to put them into action. You had to make the right decisions at the beginning. In fact, before the beginning of the season. Once the racing had started, you had to run with what you had and make the best of it. With the T260 we were always playing catch up to the McLarens.

'My main recollection of that CanAm series is that Jackie Stewart gave me a hard time! He was a superb driver but, in my experience, he wasn't a development driver. As far as I recall, we never did any development running with him. I certainly never went testing with him, he would literally fly in just for practice and the race - obviously he was committed to other things. Having said that, I'm certain that a lot of the results the T260 achieved were mainly down to Stewart. He drove the wheels off it. If it hadn't been for him, I think we would have been a lot further down the field.'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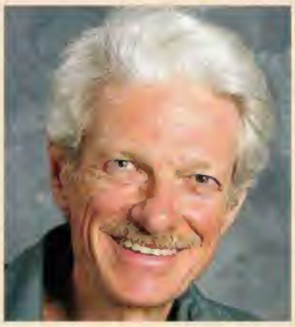
Polar moment of inertia

What it is and what you can do with it, or without it



Mark Ortiz Automotive is a chassis consulting service primarily serving oval track and road racers. Here Mark answers your chassis set up and handling queries. If you have a question to put to him
Email: markortizauto@windstream.net
Tel: +1 704-933-8876
Write: Mark Ortiz
155 Wankel Drive, Kannapolis
NC 28083-8200, USA

Q One of my racing buddies used the term 'polar moment of inertia' in a conversation we were having the other day. I have heard this expression before, but do not understand what it is. Could you explain it, and also what effect it has on a racecar. Also, can you measure it somehow? And how does it relate to suspension design and / or coilover placement?

The way racers use the term, it means polar moment of inertia in yaw, but a car also has a polar moment of inertia in roll and pitch.

Yaw is a rotational, or angular, motion about a vertical axis (ie rotation that changes the direction the car points). To take a turn, we must accelerate the car in yaw in the direction of the turn during entry, then decelerate it in yaw (accelerate it in the direction opposite the turn) during exit. We must start it rotating to make it turn, then stop the rotation to make it go straight again.

In this way, the car acts as a giant flywheel – its inertia opposing these accelerations. When it's running straight, it doesn't want to start rotating but, once it's rotating, it wants to keep rotating. This effect tightens entry and loosens exit.

The polar moment of inertia is the magnitude of this inertial effect. We increase it by moving masses away from the c of g. We decrease it by centralising masses. A mid-engine car, like an IndyCar, has a small polar moment of inertia in yaw. A stock car with the engine between the front wheels and 200lb of ballast ie the battery and the fuel load behind the rear axle has a large polar moment of inertia in yaw. So does a VW Beetle, a front-wheel drive Audi or a Porsche 911, all of which have the engine outside the wheelbase.

MEASURING YAW INERTIA

Most people don't try to measure yaw inertia, though GM built a giant turntable fixture to do just that. You can mathematically estimate it by breaking the car down into components, weighing these or calculating their mass, and multiplying the masses by the square of their distance from the c of g. Most of us don't bother. For a pure racecar, we just try to put all the heavy stuff as close to the middle, or the expected c of g, as possible.

For a production-based car, we often face the issue as a choice between placing components or ballast toward the rear bumper to get more rear percentage, or more centrally to reduce yaw inertia. In such cases, I usually go for the rear percentage, especially for oval track applications. An exception would be where you can get more than enough rear percentage, and still fall short of legal minimum weight. Then it makes sense to centralise the ballast.

On an oval track car, we can use asymmetrical set ups to make the car enter and exit as loose or tight as we want, even if the car has a lot of yaw inertia. Also, we don't encounter such abrupt changes of direction on an oval as we see in a chicane or sharp turn on a road course. Consequently, minimising yaw inertia is more important in road racing than on oval tracks.

Both large and small polar moments of inertia are mixed blessings for any car. A car with a small polar moment and a short wheelbase will be twitchy (eg an older Toyota MR2), unless it's set up very tight (eg a Pontiac Fiero). When such a car encounters a slippery patch in mid-turn, it will do a big wiggle and possibly spin, whereas a car with more yaw inertia will be more stable.

Suspension geometry requirements don't really change with yaw inertia. Moving coilovers toward the centre of the car reduces yaw inertia, but not a lot since coilovers aren't very heavy.

A car with a high level of polar moment of inertia in yaw will be more stable, whereas a short wheelbase, mid-engined car with a low yaw inertia will be twitchy

Springs, roll and cornering balance

Altering the set up using pre-load or stiffer springs

When you load the front tyres more unequally and the rears more equally, that improves the available cornering force at the rear

Q As I understand it, the stiffer the coil spring, the more weight is put on that corner, therefore planting the tyre more. My question is, what is the difference between the stiffer coil vs body roll? For example, a stiffer right front coil should put more weight on that tyre, giving it more bite - therefore making the car steer better. However, you used to hear all the time about NASCAR teams taking spring rubbers out of the right front when they are tight to allow the chassis to roll over on the right front, making it turn. Is it because this allows the left rear to lift, which makes it turn? Please explain, in simple terms.

Stiffening the right front spring, or adding pre-load to it, does load that tyre more, and does make it produce more cornering force, in a left turn.

However, this comes at the expense of left front tyre loading. The spring change can't change the total load on the front wheel pair, only the distribution of that total between the right front and left front. The spring change also can't change the total load on the rear wheel pair, the right wheel pair or the left wheel pair, only the diagonally opposite wheel pairs.

So rear wheel loads when cornering are also affected by the front springs. The total rear wheel load doesn't change, but its right / left distribution changes, oppositely to the front wheels.

This means that with a stiffer right front spring, the front tyres are loaded more unequally when cornering, and the rears are loaded more equally, than with a softer right front spring.

Now here's the key: when you concentrate the load on the outside tyre, you lose more cornering power on the inside tyre than you gain on the outside one. This is because grip from a tyre increases with load, but at a *decreasing* rate.

Therefore, when you load the fronts more unequally and the rears more equally, that hurts available cornering force at the front and improves available cornering force at the rear i.e a tighter car. That's the condition with the spring rubber in the right front. Take the rubber out, and you load the fronts more equally, and the rears more unequally. That helps the car stick at the front, at the expense of the rear, ie a looser car.

It works this way on dirt too, contrary to what some people will tell you.

"the spring change can't change the total load on the front wheel pair, only the distribution"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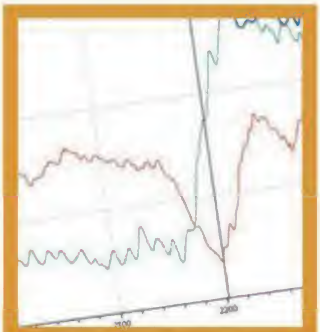


Databytes gives insights to help you improve your data analysis skills each month as Cosworth's electronics engineers share tips and tweaks learned from years of experience with data systems. Plus we test your skills with a teaser each month

To allow you to view the images at a larger size they can now be found at www.racecar-engineering.com/databytes

The truth hertz

Some suggestions for avoiding data problems due to vibration

A racecar is an exceptionally challenging environment – *g* forces of high magnitude and a considerable amount of weight being shifted around very fast demands the highest quality of components. However, the electronics often get overlooked when considering external factors and, as long as the logger doesn't rattle around and hit the driver, it is generally accepted as being mounted 'well enough'. Similarly for displays. As long as the driver can see what is needed and the display appears to stay in place, it is deemed good enough. It is, of course, very important to have all parts of the racecar properly bolted in place for the above reason, but also in order to get accurate and good data.

There are a few things to be aware of when mounting any hardware in a racecar. Most chassis are designed to be very stiff, with solidly-mounted engines and drivetrain components all transmitting vibrations at various frequencies throughout the car. This means that extra care needs to be taken when mounting data loggers as the electrical components contained therein can be damaged or their measurements can be inaccurate if they are being shaken around.

ENGINE BUZZ

Taking a closer look at the vibration possible in a racecar due to the engine and drivetrain, a racing engine will spend most of its time at the upper limits of the rpm range, typically from around 6000-10,000rpm, depending on application. 6000rpm is equivalent to 100Hz, so with a solid-mounted engine we have a very powerful 100Hz signal generator. There are potentially other sources of vibration induced by the engine too, such as valvetrain noise, gear meshing noises, turbos, induction roar etc but the most powerful could be considered the rotating mass inside the engine, often termed 'engine buzz'.

There is another potentially large source of vibration from the road wheels. Given a 2m circumference and racing speed of 240km/h, we can then calculate the driveshaft and wheel rotational frequencies at 33Hz.

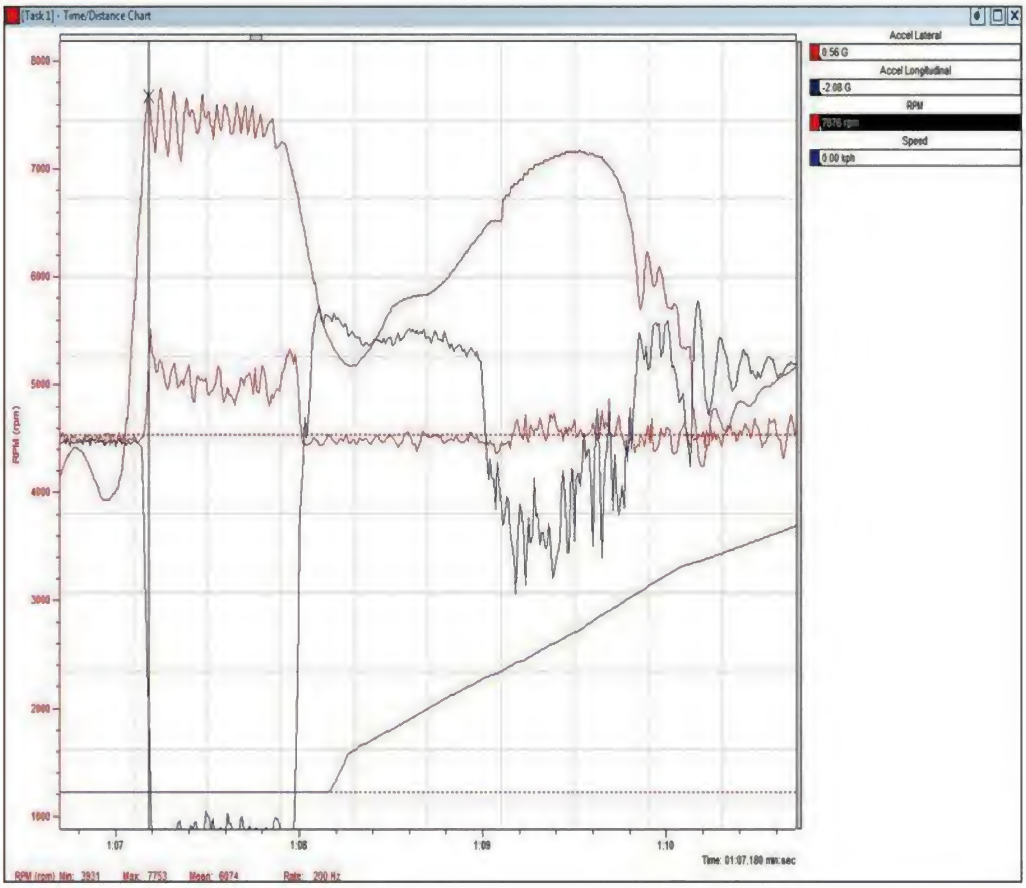
The fundamental chassis-to-tyre frequency could be in the order of 4-16Hz, depending on construction. This is interesting to measure, but often not affected by suspension tuning.

Finally, the lowest vibration is caused by the driver and race track – typically in the 1-3Hz region as the car undulates over crest and dip and around corners.

So we have a myriad frequencies and vibrations all contributing to the vibration signals on the cars. The job of an accelerometer is to measure these vibrations and the job of a data analysis programme is to try and understand the different vibration measurements.

Therefore it is important for accelerometers to be fixed securely in order to get a representative value for the acceleration being measured. However, it is also important to note that accelerometers will also pick up any vibration in the car.

The most common but unwanted vibration in a racecar comes from the 100-150Hz engine vibration. When this is transmitted directly to an accelerometer, it can saturate and give completely false readings. This can have detrimental effect on the data gathered, as the



lateral acceleration is very often used to draw a track map that much of the data analysis revolves around. It varies greatly between engines how much engine buzz is seen, with most four cylinder applications being notably worse than others due to inherently poor harmonics. In the sample below, a four-cylinder engine is solidly mounted in a racecar and the data logger has been mounted in full contact with the chassis, making it possible for the engine vibration to be transmitted to the built-in accelerometer. As can be seen, the accelerometer seems to be fine as the engine idles and the car is standing still but, as soon as the engine reaches 7000rpm, the accelerometers get saturated and show a non-realistic value.

SOLUTIONS TO THE PROBLEM

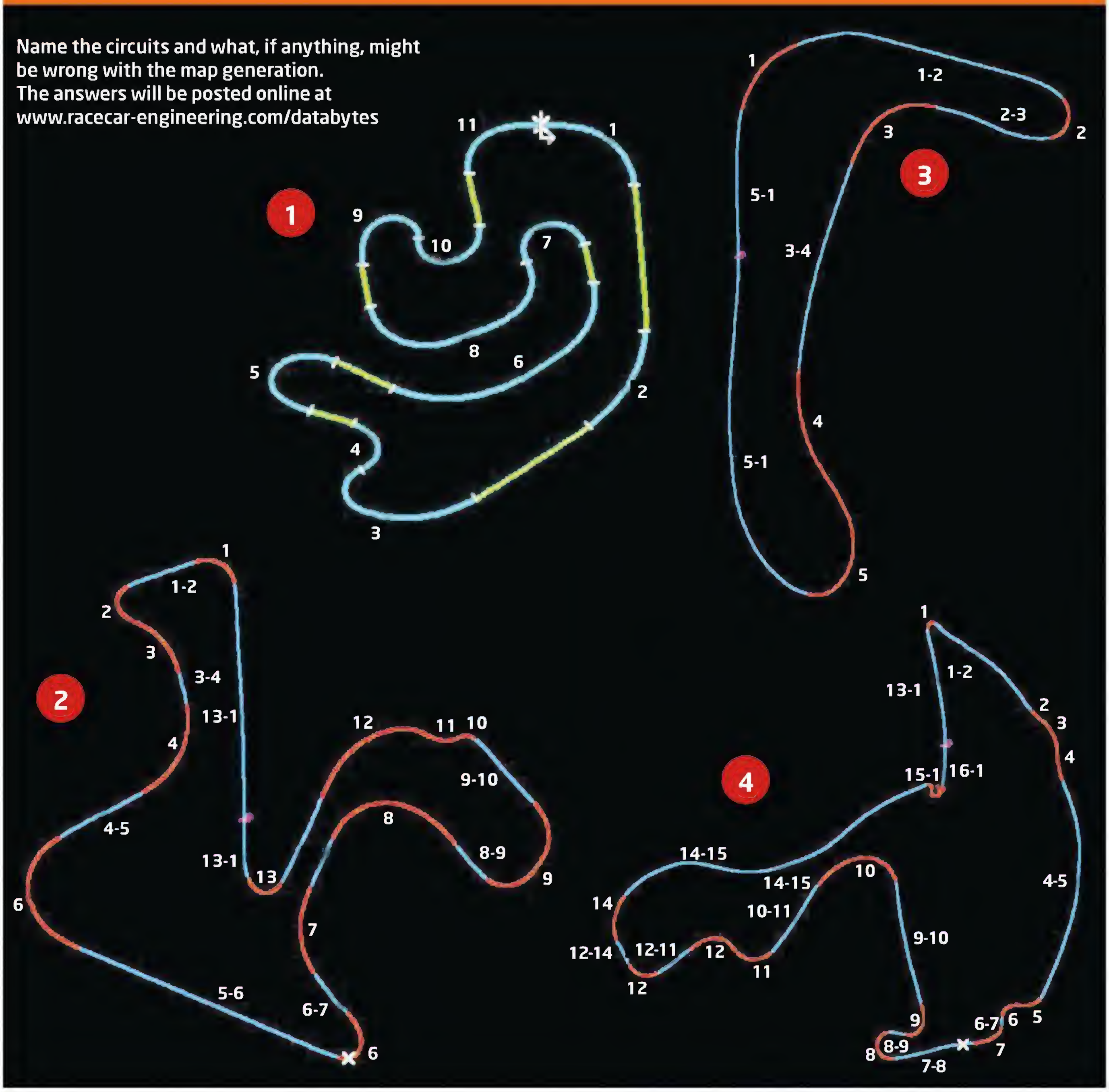
Now that the problem has been defined and realised, it is time to look for solutions. In this case the answer is normally some form of anti-vibration mount (AV-mount). There are a number of different options for various situations, the common theme being to insulate the electronics from the chassis.

The most popular form of AV-mount is a simple rubber cylinder with threads where one side can be mounted on the electronic device and the other on the chassis. These mounts are generally stiff in compression but have some give in shear, so have good anti-vibration characteristics. Surprisingly, another good AV-mount option that works rather well is heavy duty Velcro. The plastic backing has a fair amount of hysteresis and the way the individual pins interlock forms a fairly rudimentary but acceptable anti-vibration platform.

As with any engineering problem there are a number of solutions. The suggestions here will, in most cases, be enough to eliminate engine vibration coming to the logger but, if there are still problems, a more in-depth study might be needed.

CHALLENGE

Name the circuits and what, if anything, might be wrong with the map generation.
The answers will be posted online at www.racecar-engineering.com/databytes

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Comparing very different racing cars

Rounding up the study of the Arachnid and the Force LM

We're going to go back and conclude our recent Aerobytes theme this month with some summarising remarks about the pair of very different sports racers we have been studying of late. CTR Developments' Arachnid closed coupé sports racer has engine and rear wing similarities to the other car here, the Force LM of Force Racing Cars, in that both featured the Suzuki Hayabusa engine (1300cc in the Arachnid, 1600cc in the Force) and both were fitted with a DJ Engineering Services' dual-element rear wing. However, the Arachnid is a circuit racer, where drag and cooling featured more prominently on the design agenda, whereas the Force is a pure hillclimber that featured more efforts at achieving outright downforce with less concern over drag. The comparison data made very interesting reading.

The Arachnid had typical sports racing aerodynamic appendages – the upper surface downforce generators being a full width rear wing and a fairly substantial looking splitter at the front. Underneath, the splitter incorporated small diffusers set between the front wheels and the chassis, and the flat underbody continued rearwards into a wide, though fairly conservative, rear diffuser.

Table 1 - starting coefficients on the Arachnid and Force LM

	CD	-CL	-CLfront	-CLrear	% front	-L/D
Arachnid	0.534	1.084	0.115	0.969	10.6%	2.030
Force LM001	0.676	1.263	0.725	0.539	57.4%	1.868

The circuit-based Arachnid closed coupé sports racer is essentially a conventional design...

...and produced relatively low drag

DUAL ELEMENT

The Force LM is essentially the Force PC single seater with a widened chassis to meet the hillclimb sports libre regulations that prevailed when it was constructed, plus front wheel pods and sidepods that enclose the rear wheels. It utilises the same dual-element front wing as its single seater progenitor, plus a full width, dual-element rear wing. It also had a lower rear wing element and a wide and fairly shallow diffuser.

Although both cars had run fairly extensively on track and there was therefore an amount of subjective information available, this wind tunnel session was the first opportunity to assess objectively the aerodynamic performance of each car, and whether the data confirmed the subjective sense about balance in particular. As ever, we need to keep in mind that the MIRA wind

tunnel has a fixed floor, albeit with a boundary layer control fence in place, and that the racecar's wheels are stationary during testing, both of which affect the absolute downforce numbers obtained to an extent. But in each case the target for the session was to achieve an aerodynamic balance that was close to the static front: rear weight distribution with driver and half fuel aboard, together with the best downforce and efficiency attainable in the time available. As usual, and despite all the preparations that had been made in the expectation of what results might arise, the first runs on each machine served to drive the rest of the session.

"the all-important target '%front' value was achieved"

Let's take another look at the numbers from the first run on each car. In both cases data were collected at 80mph (35m/s). And in each case the coefficients were based on an estimate of the cars' frontal areas, which interestingly were very similar, despite the different shapes. As such, coefficients are directly comparable between the cars.

Table 2 - finishing coefficients on the Arachnid, and the changes relative to the first run

	CD	-CL	-CLfront	-CLrear	% front	-L/D
Arachnid best	0.449	0.915	0.409	0.505	44.8%	2.038
Change, %	-15.9%	-15.6%	+255.7%	-47.9%	+322.6%	+0.4%

NB: the seemingly very large percentage changes to the front-end parameters are because of the relatively low initial values

Table 3 - finishing coefficients on the Force LM, and the changes relative to the first run

	CD	-CL	-CLfront	-CLrear	% front	-L/D
Force LM best	0.780	1.608	0.578	1.030	35.9%	2.061
Change, %	+15.4%	+27.3%	-20.3%	+91.1%	+37.5%	+10.3%

The Force LM hillclimber is based on a single seater design with more aggressive aerodynamics...

...that produced significantly more downforce, but also more drag

MORE EFFICIENT

So the starting numbers probably reflected initial expectations in that the Arachnid created 21 per cent less drag than the Force, but it also generated 14 per cent less downforce. In simple terms that made the Arachnid 8.7 per cent more efficient, as indicated by the lift over drag (-L/D) figures.

However, perhaps the most striking thing about these first numbers was the difference in the front and rear percentages of total downforce. The Arachnid only generated 10.6 per cent of its downforce at the front and, unsurprisingly, this coincided with driver reports of understeer at 'aero' speeds. Indeed, the constructor was expecting the aerodynamic balance would show up as rear biased, and this served to validate the feedback from the track. So one of the primary session targets for the Arachnid was to shift aerodynamic balance forwards to be more akin to the static weight distribution of around 45 per cent front.

The Force was something of an unknown coming into the wind tunnel because modifications had already been carried out in an effort to prevent the front end going light at speed, as reported by the car's owner, Graham Wynn, and guest driver Will Hall, a top ten contender in the British Hillclimb Championship in a 1.6 Force single seater. An inspection of the car, which originally had a flat extension of the underbody that projected well forwards under the raised chassis, led to the notion that this projection, along with the relatively quite modest diffuser, might have been the cause of front-biased lift sufficient to overcome the downforce generated by the front wing. And the suggestion was made that shortening that forward underbody might overcome the problem. This might seem counter-intuitive, but the thinking was that the forward underbody may have been 'over-filling'.

That modification was therefore carried out ahead of the wind tunnel session but, with limited time available in the tunnel, it wasn't possible to test the 'before' as well as the 'after'. However, as can be seen from the results, in this recently modified but un-tested form, the Force actually developed a somewhat excessive front downforce percentage, especially when taking into account that the car had a roughly 36 per cent front static weight split. Clearly then, assuming the earlier driver feedback was accurate, the balance had been shifted markedly forwards with the underbody modification, and so one of the main aims during the session with the Force was to shift the aerodynamic balance rearwards again.

In recent issues we have delved into some of the details of how the balance of each car was significantly improved with subsequent configuration changes throughout the session, but we'll end this project by summarising the numbers attained in the best configurations found on each car, as shown in table 2 and 3, relative to the starting numbers.

In each case the all-important target '%front' value was achieved, ensuring better balance at aero speeds. This kind of precision refinement would be very difficult to achieve without the use of a wind tunnel.

Next month we start a new mini-series on a current specification LMP2 racecar.

Racecar's thanks to CTR Developments, Force Racing Cars and Graham Wynn

More affordable and exciting racing

The British Touring Car Championship has completed its first full season with the Next Generation Touring Car. Here's how it went

BY LAWRENCE BUTCHER

"NGTC specifications were never intended to provide a quick route to a front-running car"

The 2011 race season saw the debut of the British Touring Car Championship's all-new specification racer, the Next Generation Touring Car (NGTC). In a bold move, the series governing body, TOCA, decided to depart from the FIA's S2000 regulatory mould and strike its own path towards more affordable and exciting racing.

As a quick refresher for those that may not be aware, the concept was designed to provide cost savings through the use of a number of spec parts, while still allowing considerable design freedom.

Among the standard parts were front and rear subframes, the front featuring double wishbones and pushrod-activated dampers, a Cosworth Electronics wiring and data system, Penske dampers and AP Racing brakes. The suspension set up in particular is a major departure from the systems previously found on most Touring Cars. Thanks to the fact that the majority of modern saloon cars share relatively similar dimensions, the adoption of a standardised subframe removes the necessity of developing specific packages for each marque of car, reducing costs considerably.

The package is also designed to accommodate both front and rear-wheel drive configurations, a move made after several manufacturers showed an interest in running rear-drive vehicles. Thanks to its design and the cost savings associated with running spec parts, the price of a complete NGTC car is now in the region of £100,000 ($155,000) cheaper than an S2000 car.

The initial contract to build a prototype was awarded to GPR Motorsport, based in Buckingham, UK, with a Toyota Avensis forming the basis for the first car. The Toyota appeared on track at the end of the 2009 season and a number of teams opted to run new spec cars in 2011, with varying degrees of success.

THE NEWCOMERS

These teams, Speedworks Motorsport and Dynojet (Toyota Avensis), Welch Motorsport (Proton), Rob Austin Racing (Audi A4) and Thorney Motorsport (Vauxhall Insignia), were new to the championship, and inevitably this presented some major challenges in such a competitive environment.

In fact, just getting the cars to the grid proved a considerable challenge for the newcomers, and only the Toyotas of Speedworks and Dynojet made it to the first round of the season, with both cars completed only days before their debut. The other teams fielding new cars were beset by delays, either through glitches in the production process or a simple lack of time. While the majority of problems were minor, overall they presented some unwanted headaches for the teams.

Dan Welch, who drives and engineers the Welch Motorsport Proton, explains some of the issues they had in the early stages: 'As each bit appeared, we had to work things out without any initial drawings. There were also details; we had no list of fasteners, so we ended up

Teams running the New Generation cars were accused as having an advantage thanks to extra testing, which was subsequently removed

Team Dynojet stepped up to the British Touring Car Championship with Toyota, and had to work hard to meet the technical challenges ahead

having to go through the whole front and rear subframes listing what was needed. I thought that some guy with CAD could simply print it out. Getting hold of parts at races was also problematic, and we could not always get the components we needed if we wanted to change the set up.'

As with any new enterprise, it should not come as a surprise that there were teething problems, though some were truly elementary, such as incorrectly labelled connections on the supplied wiring loom. However, it should be noted that, as the season progressed, the procurement processes in place improved and access to data such as technical drawings improved.

EXTRA TESTING

To aid the teams running the new generation cars, the governing body allowed additional testing at each of the circuits where the series raced, providing the competitors with some much needed development time. But this process was not met with universal approval by the established teams still running S2000-specification cars. 'We were getting complaints from other teams - "If they can go testing for two days, why can't we?" - and it's possible that the extra testing artificially inflated the cars' performance in relation to those who didn't test,' admits Peter Riches, technical director at the BTCC. 'They then say, "Well, they only beat us because they came here testing and we have not been allowed to." I think this explains the drop off [in NGTC performance] towards the end of the season at Brands and Silverstone, after the testing was removed.'

Despite this extended testing allowance, some of the teams still struggled to find a consistent set up. But then the NGTC specifications were never intended to provide a quick route to a front-running car: 'I think at times they were left swimming in a sea they did not know the way out of, but Touring Cars is not designed to be easy,' says Riches. 'Sometimes they needed to sit back and think, and not work on the principal that they know better than the car designer. We had some fairly weird set ups on the cars that did not make much logical sense. But it is not our place to tell them how to set their cars up.'

This all certainly rings true with Welch: 'At times the car felt undriveable. At the limit it was not progressive and, when it went, there was no catching it.' Fortunately, most of the teams now have a deep enough understanding of their respective chassis that this is no longer the case. More to the point, several accept that Touring Cars should be a challenge, and a step up from the one-make series they may have competed in previously. 'What you have to realise is that you are buying a Touring Car kit, so there is still a lot of emphasis on the team's engineering resources,' says Frank Wrathall sr, owner of the Dynojet team. 'That is how it should be. It's not a Clio Cup car, or a Ginetta. You are given something that you can tune into a car. Obviously it's not easy, and that's the way it should be. Having said that, we had very few issues with the chassis, and when we initially ran it, the times were encouraging. As far as I'm concerned, the car was very close as it was built and it was really just a case of dialling it in.'

"there is still a lot of emphasis on the team's engineering resources"

The teams also needed to keep in mind the fact that 2011 was a development season for the new cars. This meant they had to go against the usual racers' instinct of keeping any performance advantage a secret. Initially, TOCA were willing to let teams push the boundaries of what they could run within the rules, recognising that developments could be beneficial to the programme as a whole, but it soon became apparent that changing a racer's mindset can prove tricky: 'There were a few occasions where people seemed to think, "We've found something that nobody else is going to find and won't tell TOCA". But that doesn't help the development. They have to play for the good of everybody,' highlights Riches. 'Given that we were relatively lax on what we would let them try, we had to clamp down on that when they stopped telling us what they were trying, on the basis that potentially they were running outside the rules. Maybe there was a better set up outside the rules which, if they had shared it with everybody, we could have said okay to, and modified the parts accordingly. Then the set up could be better.'

Despite these issues, the relationship between the new teams and TOCA has still been a productive one, with TOCA receiving and responding to feedback. 'TOCA have been unbelievable. They could not have been better in the way they have responded to issues we have found,' states Wrathall enthusiastically.

RESOUNDING SUCCESS

There is no doubt that the new TOCA-spec engine has proved a resounding success, and the turbocharged 2.0-litre formula looks set to stay. Ultimately, producing in the region of 300bhp, reliably, from an engine of this size leads to a relatively low stressed unit, and many teams who have adopted the new motor have also seen considerable reductions in running costs.

Teams can choose to use either a TOCA-supplied engine, produced by Swindon Race Engines, or develop their own unit to TOCA's specification. While a number of teams have opted to run the former, in both S2000 and NGTC cars, several chose to develop their own units, with varying degrees of success.

Wrathall admits that deciding to run with a development of Toyota's 2.0-litre engine, compared to using the TOCA-supplied engine, produced more issues than the team would have liked during its first season: 'We


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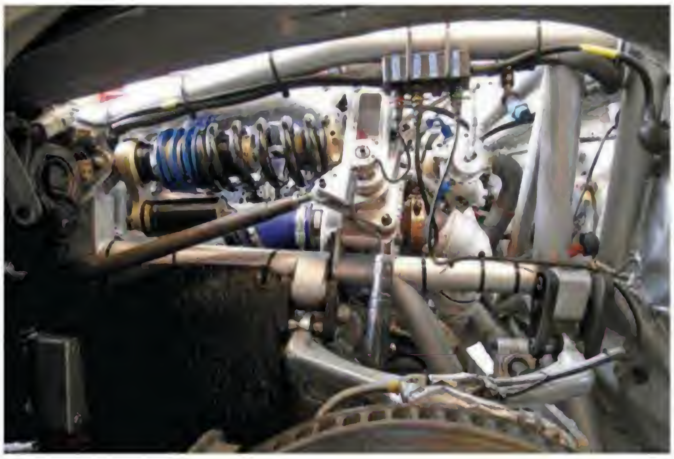

Spec front and rear subframes with pushrod-actuated dampers are a major departure from previous BTCC practice, and can accomodate FWD and RWD

made it difficult for ourselves because we opted to run with the Avensis engine, giving ourselves double trouble, and we struggled at the beginning of the year. Out of the box we didn't have any real problems with the chassis, it was engine issues that plagued us.'

"one of the big disappointments of the 2011 season [was] that none of the big teams ran the new cars"

TOCA recognises there will inevitably be differences in engine performance and has implemented a flow testing programme under the direction of Lotus Engineering to benchmark each of the units. BTCC series director, Alan Gow, explains the reasoning behind this: 'The purpose of this programme is not to make every race engine perform in exactly the same way – it's only right that the best engineering, the best design, the best teams and, of course, the best drivers still see their efforts related to their on-track performances. The test programme is simply to reduce any wide performance variances resulting from significant differences in the fundamental port / valve designs of the original production engines. It will identify and quantify those that produce superior airflow through the cylinder head and those that don't, so their baseline turbo boost pressure is set accordingly.

Thereafter, during the course of the season, a strict mathematic calculation – based on a rolling average of each model's qualifying and lap times over a set number of events – will determine if any further changes should be made to their respective boost levels.'

Given the superiority in terms of both cost and performance of the new generation turbocharged engines, it is unlikely that there will be a competitive naturally aspirated car in 2012, if indeed any are present at all on the grid. Technically, this should make life easier in terms of performance balancing for the organisers, with boost pressure adjustments being a simple and effective means to reel in any team that has too great a power advantage.

THE FUTURE

TOCA says it hopes the BTCC field in 2012 will be made up of at least 50 per cent NGTCs, with some of the established top teams coming on board with the project. This will address what Riches sees as one of the big disappointments of the 2011 season, that none of the big teams ran the new cars. Notable amongst those changing to the NGTC formula for next season is Honda Racing, who will be fielding an all-new Honda Civic. Given the resources available to that team, it is likely this will be the first true insight into the potential pace of the new package. However, the experience gained by the new teams in 2011 will stand them in good stead, having had the opportunity to iron out teething problems in their debut season.

Despite only having run for a portion of the championship, Wrathall is happy with the results achieved so far: 'It has given us two key things – Touring Car experience for the team and driving experience for Frank (jr). But, more importantly, we now know what to do to make the car go faster, which we can implement this winter. The good thing about it is that I never wanted to do something where you do not have a big engineering input. With this package you can make a difference, with good engineering within the freedom of the rules. Even the big teams will go through a period of learning. Obviously, they have greater resources and more staff, but I think it is possible for a smaller team to be competitive.'

Despite some initial concerns, it would seem that the NGTC has done nothing to water down the challenge of the BTCC, rather adding to it for the teams that have already made the switch. And it appears to be saving those teams money, too. Wrathall, with a full season now under his belt, is positive about the future, but warns that teams should be under no illusions: 'If anyone is heading into the NGTC thinking it is like a one-make series, where you pick up a car and race... they are in for a shock. And that is exactly how it should be.'

DARK MATTER

On a front-wheel drive Touring Car, tyres are always a limiting factor and managing the spec Dunlops efficiently is a key contributor to success in a race. Peter Crolla, team manager of Team Dynamics, explains that the first challenge is getting heat into the under-utilised rears. 'We send the car to the grid on tyres that have been scrubbed in free practice. When it arrives on the grid, there should be approximately seven minutes before the start of the green-flag lap to cross the fronts and rears. That means the left front swaps with the right rear and vice versa. This puts the hotter tyres on the back of the car ready for the race.'

Once the race starts, tyre management in the early laps is crucial. 'The drivers have to stay off the kerbs for the first two or three laps because until they come up to full temperature and pressure they are very vulnerable to damage.' At this point the drivers can push harder and this is where you see experienced drivers catching the early leaders.

'A lot depends on the circuit and weather conditions but, after the initial drop-off at the start of a race, the tyres tend to degrade gradually throughout the 25-minute race, but they have been marginal at some events, particularly in hotter conditions.'

Charles Armstrong-Wilson

To efficiency, and beyond

BY CHARLES ARMSTRONG-WILSON

The F1 engine rules for 2014 are designed to take a more responsible approach to energy consumption and push energy management technologies to the limit

With a maximum capacity of 1.6-litres and a mandated 80mm bore, stroke is necessarily a maximum of 53mm, which is what Mercedes has chosen to go with on this engine. Rpm in 2014 is to be limited to 15,000rpm

After years of tinkering around the edges within the current engine freeze rules, 2014 brings a whole new raft of challenges for Formula 1 engine manufacturers. The engine rule book has literally been re-written and engineers have a brand new challenge to get their teeth into.

The shift is profound, as Andy Cowell, engineering director of Mercedes AMG High Performance Engines in Brixworth, UK explains: 'The spirit of the regulations is going from where the power is controlled by revs and capacity to where it is controlled by a fuel flow,' he said. This may not be a new idea – Keith Duckworth of Cosworth proposed it for F1 more than three decades ago – but, whatever the arguments for it in the past, the global mood of the moment regarding energy supply and the environment has made it a particularly relevant solution.

The rules were thrashed out with the engine manufacturers and Cowell, as someone party to both drafting and exploiting them, is a good person to comment. Despite the first season under the new rules being two years away, Mercedes has already constructed the first version of its engine, which is due to run on the dyno soon. It may seem early but the importance of iterative engine development is fully appreciated at Brixworth.

BY THE NUMBERS

The power unit's architecture is largely dictated by the rules, so the Mercedes engine is a turbocharged, 90-degree V6. An 80mm bore is mandated by the rules so, as Cowell points out, the company has no need to explore other alternatives, meaning one less variable to consider.

"five [power units] per driver per season, dropping to four for 2015"

"the importance of iterative engine development is fully appreciated"

Coupled with a maximum capacity of 1.6-litres, the bore size dictates a maximum stroke of 53mm, or a bore-to-stroke ratio of 1.5:1. However, with the current normally-aspirated engines, ratios of 2.5:1 are allowed and Cowell hinted that it may be better to go for a more advantageous ratio, even at the expense of capacity. But, then again, as there is currently no turbo boost limit in the rules, a capacity deficit might not be the handicap it at first appears.

Usually, the appeal of extreme bore-to-stroke ratios is to keep piston speeds down when pushing revs higher, but the 2014 engines will be limited to 15,000rpm, ultimately dictating the potential for gains in this area.

Recalling the last turbo era during the 1980s, when engines were delivering between 1000-1500bhp in qualifying trim, the scope for runaway power development seems unlimited, but this is where the fuel flow formula steps in. From 2014, F1 cars will be constrained to a maximum fuel flow of 100kg/h and a maximum fuel load of 100kg. That is about 35 per cent less than today. Obviously, if this fuel flow was used continuously from the start, the car would not make it to the end of the race, so the rules also only allow this flow rate above 10,500rpm. Below this, it is dictated by a formula down to 5kg/h to zero rpm. This is to prevent manufacturers coming up with low revving engines that develop very high torque. 'It is about internal combustion engine efficiency and energy management using the ERS (Energy Recovery Systems) for best lap time,' says Cowell.

ELECTRIC AVENUE

The mass flow rate also provides a challenge for the fuel manufacturer. As Chan Ming Yau

KERS was first used in 2009, and made a return in 2011, but Energy Recovery Systems (ERS) will play a major part in Formula 1 from 2014 onwards

All current Formula 1 cars use 2.4-litre, non-turbocharged V8s. The new Mercedes 1.6-litre V6 engine is a massive departure from current engine practice

of technical partner, Petronas, revealed, the company is working toward mass and power density targets in an effort to maximise performance.

However, unsurprisingly, the rules have shifted the emphasis even further toward energy recovery. Engines are allowed a single turbocharger and a mechanical drive can be taken off the turbine shaft to generate electricity, with significant controls in the rules regarding turbo design and position. As

"a maximum fuel flow of 100kg/h... above 10,500rpm"

Cowell points out, 'If you allow a group of Formula 1 engineers to turbocharge an engine, and you don't put technical constraints on it, you'll end up with a very big project. You'll have a gas turbine on the back end and it'll be an external combustion engine.'

The regulations therefore dictate a single-stage compressor and prohibit any variable geometry on the hot exhaust side. So, no variable nozzle technology of the type found on road cars on the turbine, although the same area on the compressor seems to be free. The link between the turbine and the compressor must be a common shaft, with no step ratios, parallel to the crankshaft axis and no more than 25mm from the centreline.

'Hence the location of the compressor and turbine housing,' says Cowell, 'so we're all doing the same. If we had complete freedom we would have two turbochargers for the two banks but then we would have doubled

ENERGY RECOVERY SYSTEMS

Mercedes was quick to take up the challenge of Kinetic Energy Recovery Systems (KERS) when they appeared on the scene in 2009. Opting for an electro-mechanical system, the company developed its own system from scratch in house, with help from outside specialists. With the new energy recovery rules on the horizon, this approach is now serving them well.

The original system used in 2009 was the best and most reliable KERS to see action that season. It was also the first system to be used on a race-winning car. By the end of the year the teams, most of who had not managed to exploit the technology successfully, all unanimously agreed that it would not be used in 2010. So the Mercedes system was shelved, but not before the technology was put on the dynos at the Brixworth factory once more and thoroughly interrogated to capture as much data as possible.

At the factory, there was a belief that it would be back in two or three years time, but even they were surprised when it came back just two years later, in 2011. That previous work and banked knowledge then came into its own, and the new system has improved the round trip efficiency of the system from 75 to 80 per cent. It has also been laid out in the car differently. The 2009 system had the batteries in one sidepod and the control unit in the other, but re-packaging has allowed them both to be installed under the fuel tank within the monocoque. This frees up the bodywork for aerodynamics and protects the batteries in an accident.

In 2009 there was much talk of the batteries having a short life and being renewed every race. In reality, Mercedes has found they outlast the life of the engine, while still delivering good efficiency. It is only other service items within the battery pack that forces them to be replaced. The secret, according to Cowell, is good management of the batteries, by maintaining their charge levels within an optimum band and keeping their environment cool.


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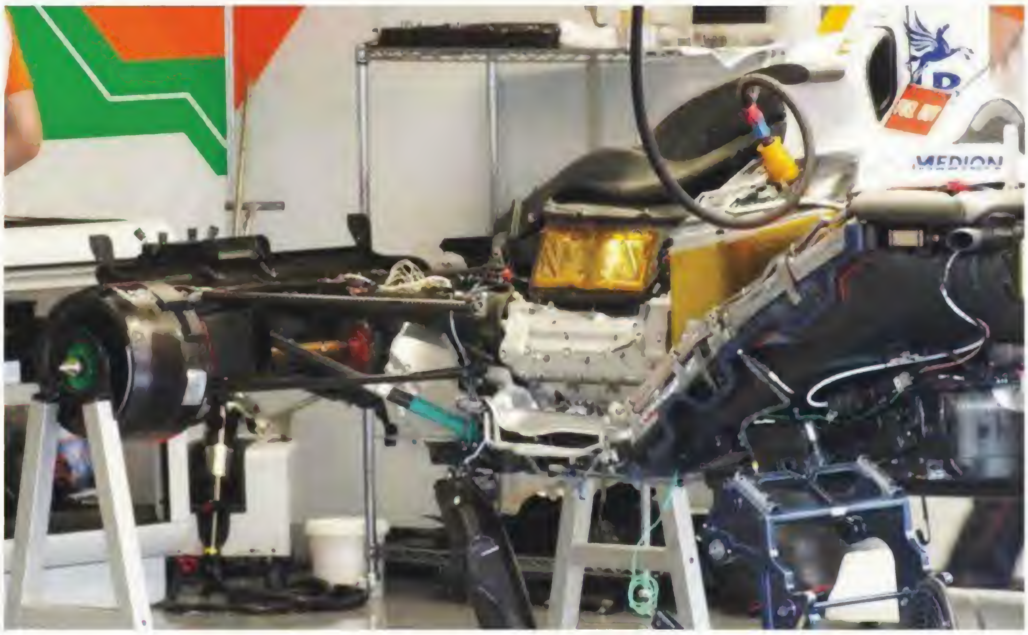

Mercedes AMG HPE currently supplies teams such as Force India (above), and will continue to do so in 2014

the cost. It's a technology constraint we all agreed in a meeting chaired by the FIA and we're all in the same boat. But we all have the freedom to develop own aerodynamic surfaces within the compressor and the turbine.'

Instead of Kinetic Energy Recovery Systems (KERS), the new cars will be allowed Energy Recovery Systems (ERS) that embrace energy recovery via all means. That includes a Motor Generator Unit Heat (MGUH) extracting energy from the turbo and a Motor Generator Unit Kinetic (MGUK) recovering energy under braking.

'It will be up to you to decide what power level you recover the energy from the turbine,' explains Cowell. 'If you recover a lot at a high rate, the back pressure on the exhaust will become high because the turbine creates more of a restriction and the internal combustion engine performance will decay. We have that balance to work out ourselves.'

However, the rates of kinetic energy generation under braking is limited to no more than 2MJ per lap. More is available from the MGUH but no more than 4MJ can be returned to the drivetrain on any single lap. That's quite a lot of energy, but they will need it as, for 2014, the cars are only allowed to be driven through the pit lane on electric power.

"significant controls in the rules regarding turbo design and position"

The new regulations also include a rule that cars have to be able to be started by the driver sitting in the driving seat without any external assistance. A tough call and we struggle to think of a penalty from the stewards that will exceed the forced retirement from the race.

In 2014 the stored energy can be deployed at a rate of 120kW, twice the current KERS limit of 60kW up to the total of 4MJ. 'That's 10 times the [KERS] energy to propel the car today,' observes Cowell, 'but through a machine that's double the power. So, that will be five times the duration, or 30+ seconds of propulsion if you operate at that maximum of 120kW. We're getting to a level where the additional electrical propulsion is for very nearly the same amount of time as the internal combustion engine on its own.'

AREAS OF FREEDOM

Within these restrictions, what does Cowell see as the most fruitful areas of freedom? 'Combustion chamber design, port design, fuel injector location, the design of turbine map and round trip efficiencies of the ERS is free. So it is an efficiency formula. The number of power units is five per driver per season, dropping to four for 2015, so it has got to be reliable and got to be highly efficient.'

And what power outputs should we be expecting? Cowell is cagey on this, but says, 'I think it will be wonderful if, with this power unit, our lap times are the same as they are today while we are emitting 35 per cent less CO_2. If all the manufacturers target that, I think it'll be wonderful for the sport.'

ENGINE USAGE

With 20 races and eight engines for the season, it was important to allocate them most effectively, says Cowell. And with Friday practices and the Saturday / Sunday race weekend, the total possible number of permutations is around 36 billion. Mercedes starts by looking at the characteristics of different races. Some put greater inertial loads on engines, while others are more about gas pressure loadings. 'We try to mix the different types of circuits on each engine,' says Cowell. 'An engine degrades differently depending on whether it has been having a hard time from inertia or a hard time from gas loading. So, if an engine has raced at a high-inertia circuit we will then save it for a high gas pressure event like Spa or Monza. Finally, we'll give it a less demanding race like Monaco or Singapore.

'We also try to front load our engine usage to give us extra capacity toward the end of the season. So we put all these parameters into a big computer and press 'go'. That gives us the plan, but then things happen during a season.' First, there was the cancellation of Bahrain that, while it reduced the mileage requirement of the engines, it upset the running order. 'It would have been tough on cooling and high on fuel consumption, so we would have had to run the engines lean.'

After that, the company was continuously responding to events. If an engine was showing well, they could squeeze more mileage out of it. One engine managed more the 3000km this season, while typical was around 2000km. And there was only one engine failure across the six cars in 2011 - Jenson Button at Monaco.

Circumstances during a race can have a big effect on the life of an engine, too. 'A year or two ago you would often see cars retire two or three laps after re-start from a safety car period.' The cause is that temperatures would drop below the engine's ideal operating zone. This can cause all sorts of problems as piston clearances open up and the viscosity of lubricants increase. Drivers are therefore briefed to bring temperatures back up again toward the end of the safety car period by using more throttle.


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Formula fuel

With all the talk of economy in motorsport, restricting fuel flow is undoubtedly the answer. Here's the solution

BY SAM COLLINS

Balance of performance, success ballast, reverse grids... They're all methods currently being employed across motorsport to level the playing field and stop everything becoming a spending race. Keith Duckworth saw all this coming years ago, and argued that rather than issue a car with a set amount of fuel for a race, which produces a pointless economy run before a wasteful dash to the flag, a set rate of flow promotes flat-out racing throughout, because hoarding fuel means extra weight sloshing in your tank.

EFFICIENT INNOVATIONS

'Efficiency becomes the primary performance objective,' says Ben Bowlby, free-thinking creator of the Laurel Hill Tunnel aerodynamic test facility and the Delta Wing. 'Reducing exhaust heat, friction and unburned fuel in the exhaust pipe will be paramount. It would be simple to slow the cars, and do so in a way that encourages efficient innovations, rather than removing them because they make the cars too fast. But we say, "keep it, just burn less fuel." That's the storyline the auto industry wants. The industry has to keep cars desirable, meet government-set emissions targets, and deliver on performance and safety.'

Until recently, the issue had been the variety of fuels and the lack of truly accurate flow measurement equipment but, thanks to a chance meeting at the Autosport Show, all that may have just changed. 'I was walking the show and saw this ultrasonic oil flow meter from Gill Sensors and got talking to the guys there about whether it could be used for fuels,' explains Andrew Burston, an automotive engineer who specialises in alternative fuel solutions for motorsports. The result is the ultrasonic fuel flow sensor.

Mechanical flow meters do not cope very well with violent pulsed flows, typical of the sort generated by modern fuel injection systems. Those devices that can cope with pulsed flows, such as those used on top end dynos, are kept isolated and could not withstand the vibrations of a modern racecar. Exploiting Gill's long experience of harsh environments, from supplying humble tractors in the early days to today in aerospace and Formula 1, Burston developed the new sensor into a highly versatile device. It is solid state and contains no moving parts, which further helps it withstand the tough environments of a racecar's engine bay.

"a set rate of flow promotes flat-out racing throughout"

'The objective from day one was to make a sensor that can be bolted into any racecar and be impervious to the harsh environment conditions that entails,' says Burston. 'Inside the blue box there is a tube of a particular length and, at each end, there is an ultrasonic transducer. An ultrasound wave is transmitted from one end and, when it is received at the other, it is essentially transmitted back. If there is no flow, the time taken in each direction will be exactly the same, but if there is flow in either direction there will be a slight difference. As you know the diameter of the tube you can calculate the volume flow rate. If you add a temperature compensation and the properties of your fluid, then you can get to a mass flow rate.'

In Burston's mind there are two main types of application where the new sensor could be used. Firstly, by a team simply using it to meter fuel flow for their own information. Secondly, from the wider standpoint as a regulatory device. And with Formula 1, IndyCar and Le Mans all leaning towards fuel flow restrictions, for which of course a reliable, accurate flow meter is required, this is where the real interest lies. 'We have set up a new organisation to handle this device in a regulatory capacity so, if a series wanted to use it, we would manage distribution and track-side organisation. That would include management and checking at the track.'

The new sensor will be on sale by the time you read this, and has already been track tested in a Le Mans Prototype. It will almost certainly find its way onto a lot more cars in 2012, and could spell the end for artificial measures such as balance of performance.

Where mechanical flow meters fail, the ultrasonic flow meter could excel

Under pressure

The introduction of the new DW12 Indy car is beset by problems

BY MARSHALL PRUETT

Power, weight, downforce, drag, grip and balance. Those are the six key elements that dictate the lives of racecar drivers, designers and engineers.

As the IZOD IndyCar Series has found with its new Dallara-built 2012 chassis, miss any one key by a small margin and the overall package will suffer. Miss the key in two or more areas and, like a guitar with multiple strings out of tune, no one will want to play the instrument.

With IndyCar acknowledging a few areas that require immediate attention (weight / weight distribution, balance and drag), and others pointing to the need for a major re-think on the levels of power, downforce and grip needed next season, it's clear a lot of tuning and tweaks will take place before 28 March, the first race on the 2012 calendar.

DESIGN PHILOSOPHY

The general design philosophy for the Dallara DW12 centres on achieving a level of performance that would surpass the previous Dallara IR07 package through two main factors: a significant weight reduction and an even greater drop in aerodynamic drag.

The DW12 was conceived to be lighter on its feet and more slippery through the air, to be nimble on road and street courses, as well as on ovals, and to do all this using a smaller, more efficient engine. But, as recent tests have shown, a discrepancy between the expected lesser weight / lower drag figures in Dallara's digital world and what the DW12 has so far delivered has been a cause for concern for all involved.

For IndyCar teams, the new car price tag came with the promise of greater performance, but so far, the DW12s have been 10-15mph slower at Indianapolis, and just a few tenths faster on road courses. For the series, which expected Dallara to achieve its performance targets from the outset, the need to rush fixes into place has led to non-stop work at the IndyCar offices and at Dallara's base in Italy.

PROBLEM SOLVING

For those who've driven the DW12, general praise has been offered on its low to medium-speed handling traits on road courses, but in almost every other performance category, the positives have been sparse. To make matters worse, as each problem area is changed going forward, it affects the others, creating a cyclical loop of problem solving. The DW12's problems are solvable with time and money, of course, but who will pay for the fixes? As IndyCar and its partners embark on those multiple rounds with the DW12, and with the clock winding down, they can ill afford to make more mistakes.

The biggest problem for the DW12 is an excess of weight, and specifically, where that weight is found within the chassis. Originally expected to weigh 1380lb (626kg), 185lb (84kg) less than the 2011-spec car, the DW12 has only shed in the region of 100lb (45kg). According to Will Phillips, IndyCar's vice president of technology, the DW12's unexpected rearward weight bias (according to sources, it was delivered with a staggering four per cent rearward shift) can be attributed to a number of vendor-supplied items being delivered well above their specified weights, meaning most, if not all, of that weight falling on or behind the rear axle.

'Dallara did not go out to put [the weight distribution] where it is now,' said Phillips. 'They were expecting it to be closer to where it was [specified]. Now, obviously, as you go from the wheel centreline towards the back of the chassis, any weight saving change will be helpful. So if we can pull weight out of the gearbox, if we can pull weight out of the diff, there'll be much more benefit than the same amount of weight coming off the engine, for example.'

When pushing the car hard at Indy, drivers noted the DW12 exhibited dangerous handling traits on corner entry and exit. With the rear-heavy car wanting to spin once they began to turn, drivers found it like a pendulum, swinging back in the opposite direction as they left each turn.

Calls for the DW12 to be harder to drive notwithstanding, its test pilots found that to safely negotiate Indy's four corners, lifting off the throttle and coasting was vital. With the oval equivalent of a dragster on its hands, immediate action was required by the series and the car's manufacturers.

> **"the oval equivalent of a dragster"**

Quantified numerically, the 2011 Dallara-Honda had a delicately balanced but safe weight distribution of approximately 45 per cent front and 55 per cent rear, while the DW12's numbers as it first appeared are closer to 41 / 59.

SHEDDING WEIGHT

IndyCar has worked with Xtrac to reduce the weight of the gearbox and has progressively shed some 8.8lb (approx 4kg). Beyond paring weight from the aluminum housing, a change in philosophy on the internals was made in an effort to aid the DW12's oval handling issues. 'For the speedways, we were, for reason of economics, just going to put a blocker inside the road course differential and so save componentry,' Phillips explained,

'but because of concern over the weight distribution for the ovals we're now looking at opening up an option of a lightweight spool, which could be fitted for the ovals. That would give us another 6.6lb (3kg) or so of weight saving, right where we'd like it.'

Replacing the aluminum gearbox case with a magnesium unit, and making the bellhousings from the same material, would offer significant further savings (another 6.6lb / 3kg), but the costs involved would likely cause an uproar amongst team owners, making it a worst-case option.

Engine weights (with the possible exception of Lotus), including all of the ancillary components involved with forced induction, have also come in a bit heavier than expected, which is perhaps a bigger problem to solve. 'It gets a little harder as you go forward from the gearbox and bellhousing,' explained Phillips. 'We can look at the exhaust and turbos and the systems side of it, but the turbos are very hard to change. And again, for the engine guys, they're working to a set of regulations so they've got their guidelines to stick to. Some of the initial weight projections for the engines, perhaps over a year ago, were very, very competitive.

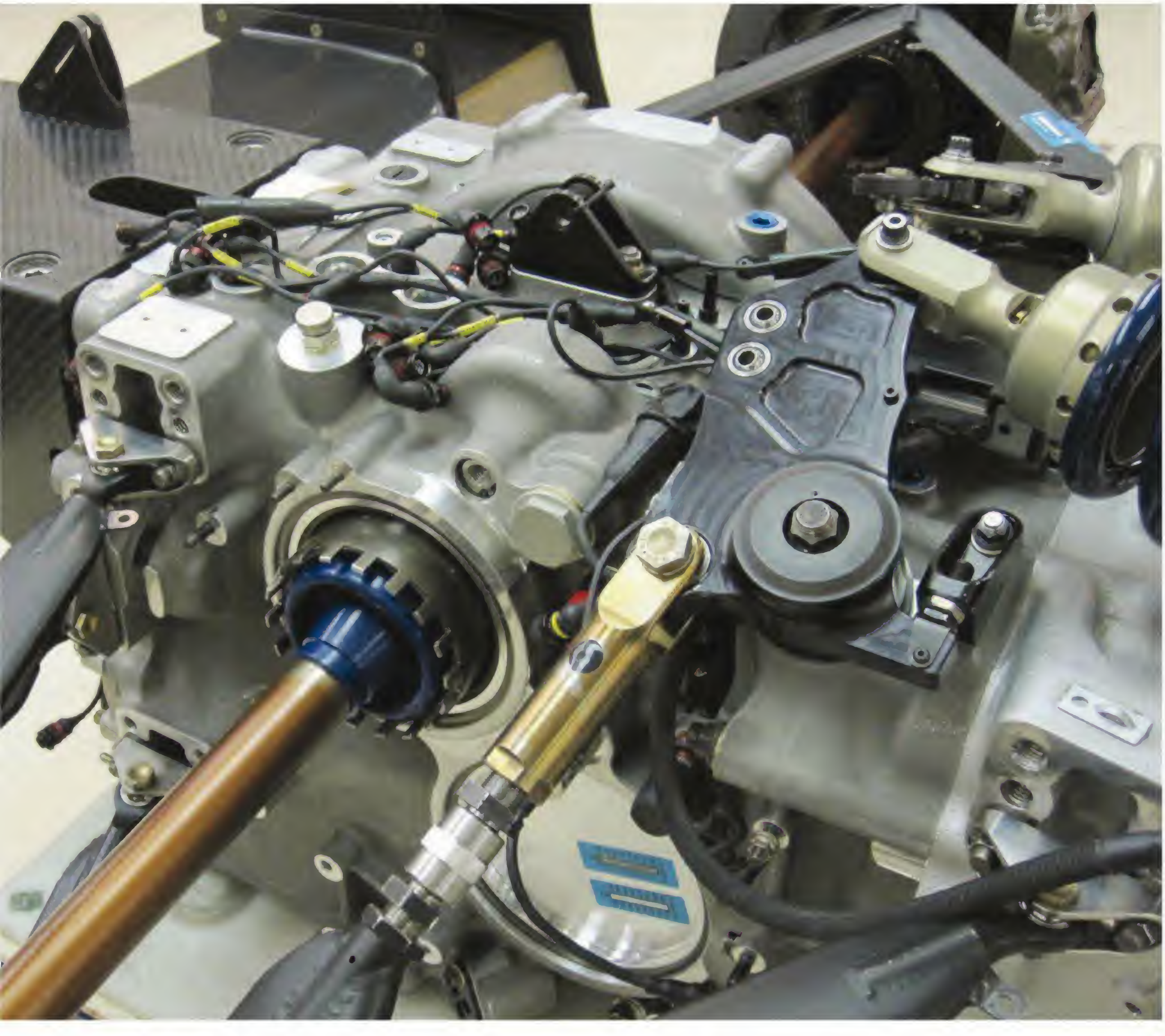
'The people that laid out the car a year ago expected one thing, but that's also added to the rear weight distribution [problem].'

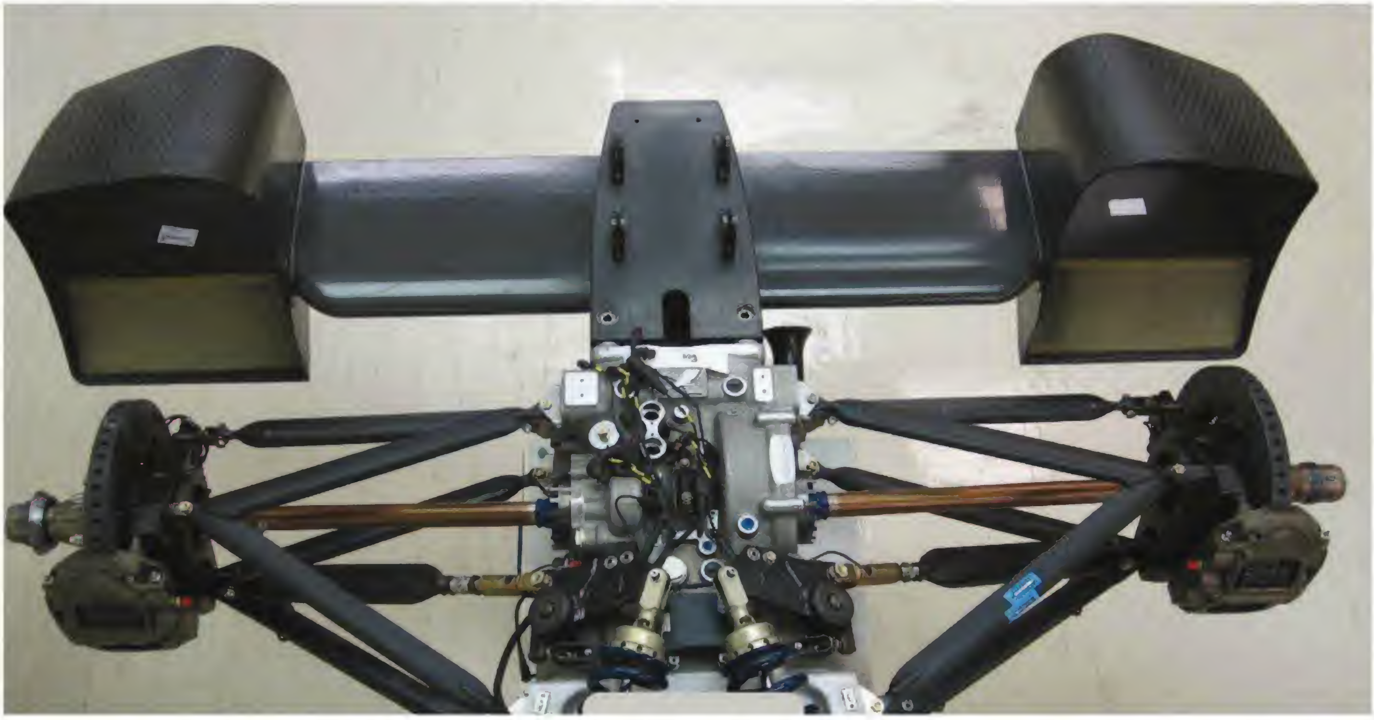
Phillips confirmed that engines from Lotus, Chevrolet and Honda will be required to meet an identical minimum weight, and for those who come in light, ballast will be used in a spec location, yet to be determined. The original minimum weight target for the 2012 powerplants was 220lb (100kg), but that figure has since changed, at the behest of the three marques, though the new figure has been kept private.

SUSPENSION CHANGES

Altering the wheelbase of an open-wheel car has been popular practice to affect weight distribution for decades, but the DW12 was designed around a fixed wheelbase of 120in (3048mm). To move the weight distribution number forward, sweeping the DW12's A-arms back would help to place more weight on the nose, but would entail major alterations to the bodywork, aerodynamics and the mechanical components at the rear. 'Dallara has looked, but the rear geometry already sweeps the rear wheels back and it might induce issues with excess driveshaft angularity,' confirms Phillips. 'They feel that

Below: Xtrac has been paring weight from the aluminium gearbox casing but cost concerns prevent going to a magnesium unit. A lightweight spool may be introduced for oval tracks





One option for addressing the weight distribution issue is to alter the wheelbase by sweeping the DW12's rear A-arms back, placing more weight on the nose. However, this would entail major alterations to the bodywork and place undue stress on mechanical components at the rear, so is an unlikely solution

they'd open up negativity for a different reason and make the cars nervous through a too-short wheelbase, rather than gain the benefit of a half a per cent forward weight shift.'

TYRES AND PODS

As with everything on a racecar, any change inevitably affects something else, and so as work continues towards fixing the DW12's weight distribution, Firestone, IndyCar's official tyre partner, is having to keep pace with changes of its own. As with any spec racing series, tyres are tailored to the specific needs of the chassis and Firestone's 2011 IndyCar tyres were developed to match the IR07's weight and its weight distribution.

During testing of the DW12 that ran through mid-October, 2011-spec Firestones were used but, once engine manufacturers took over testing duties from mid-October through mid-December, the company began testing its 2012 tyres, in conjunction with the factory Chevrolet and Honda programmes.

Further adding to the problems are the bulbous, new-for-2012, rear wheel anti-interlocking devices, dubbed 'rear wheel pods' by Dallara, which weigh in at almost 15lb (7kg). The three-piece structures, comprising a main beam, which mounts to the larger 2012 crash attenuator, and the pair of pods that affix to the ends of the beam, spreads more mass behind the car and outward past the rear wheels. However, for the purpose it serves – to prohibit cars taking flight by riding over the rear tyres – the extra weight and rear weight distribution bias it adds is a necessary performance penalty for everyone to carry.

DRAG REDUCTION

If the well-documented problems and possible solutions to rectify the DW12's weight / weight distribution issues weren't enough to tackle, the anticipated massive reduction in aerodynamic drag is also in need of an immediate fix.

While the 41 / 49 per cent weight distribution forced drivers to avoid the throttle in Indy's corners, the car also experienced an unexpected excess of drag. The result was average lap speeds in the 208-216mph range, compared to Alex Tagliani's 2011 Indy 500 pole average of 227.4mph, and alarm bells went off when the DW12-Honda driven by Franchitti and the DW12-Chevrolet driven by Kanaan were unable to get within 10mph of Tagliani's speeds in the old (but trimmed out) Dallara IR07.

With engine manufacturers playing things somewhat conservatively during the early tests at Indy, having more power on tap would almost certainly bump speeds over the 220mph mark, and with the lighter rear components on the car, speeds would jump appreciably as the drivers would be able to carry some degree of throttle through the corners but, to get close to Tagliani's pole speed, shedding drag is still a requirement.

"even further down the undesirable 'too much downforce / not enough power' path"

'At the Speedway we aren't matching where we should be in their theoretical world, and that's what they're trying to work on right now,' says Phillips, who wants to see qualifying speeds of 225mph and race speeds of 221mph. 'So instead of being at 222mph, they're running no quicker than 216. They run the car at 214, for example, do various changes and that next run correlates to what the change should be, but they're still 5-6mph off where they think they should be.'

With almost a decade of testing and validation on the old IR07 chassis, Dallara was able to produce accurate and reliable aerodynamic figures that translated from a virtual environment to the racetrack, but it does not have that luxury with theDW12, so the programme has moved to Fontana, southern California. 'Fontana [is] basically like a big open section wind tunnel,' says Phillips. 'We can do back-to-back changes there and learn what that correlation would be for Indianapolis.'

With the first half of the 2012 chassis orders delivered on 15 December, Phillips confirmed that the initial fleet would be updated with the new lightweight items and drag-improving components after the cars have shipped, provided of course the parts perform as expected in testing.

DOWNFORCE AND GRIP

Not much has been said about an excess of downforce at Indy, but on the road courses, where the estimated 700lb of additional downforce really

Clearly, there's much work still to be done on the DW12, but the problems are not insurmountable. It's just time to achieve them that is in short supply...

comes into play, the DW12's testers have commented on the car going even further down the undesirable 'too much downforce / not enough power' path that plagued the IR07.

INCREDIBLY RESPONSIVE

With such a significant jump in downforce, similar weight, comparable power (thought to be 600-650bhp on street and road courses) and a fundamental change in how that power is delivered, something as routine as spinning the tyres out of tight corners has reportedly been a challenge with the turbocharged DW12s. However, the 2.2-litre engines (Honda uses a single Borg Warner turbo, while Chevrolet and Lotus use twin BW units) have proved to be incredibly responsive, with drivers applauding the lack of turbo lag, though noticing the reduced amounts of initial torque on offer, compared to their 3.5-litre predecessors.

Granted, the DW12 has been marginally faster than the IR07 in recent road course tests and will continue to go faster as the chassis and engine evolve, but the wicked bursts of acceleration some were hoping for isn't currently on offer. If IndyCar wants to hold more exciting shows, raising peak horsepower levels through an increase in boost and / or revs is the most obvious choice but, before doing so, financial considerations must be taken into account. Especially as the initial performance / cost targets were a big ask in the first place. 'We're not anticipating any big changes,' said Phillips. 'One of the topics we are looking at is confirmation of the boost levels at all the circuits. It's always been in there as a guideline, and we need to underline that and say, "now that's it". But it's one of those topics that keep coming back up each time the IndyCar Engine Committee meets.'

With most teams sitting on engine contracts for the fixed sum of $695,000 (£448,500) for a pool of five engines and 10,000 miles of service, asking engine providers to dial up the power to compensate for errors in the power, weight, downforce, drag, grip and balance calculations is growing more and more likely.

'It's a topic that's been raised and something we'd have to discuss with all the manufacturers,' acknowledges Phillips. 'That's the compromise we have to be mindful of. There's a fixed price for the engine leases and, if something significant changes that affects the durability or the engine pool size, for example, it doesn't happen without a cost somewhere along the line. And we have to be very careful of managing that.'

Honda Performance technical director, Roger Griffiths: 'There are many different ways to approach this [but] there are a couple of things of immediate concern. [HPD] has signed up to provide engines at $695,000 (£448,500) and, if we need to add a sixth or seventh engine per lease because we're pushing things harder, or have to alter the rebuild life, we'll have to take a serious look at the financial impact and go from there.

"an increase in boost and / or revs is the most obvious choice"

'It's not something [IndyCar] has asked us to do yet, but obviously, we'd be foolish to think we can just do nothing. We all want this to be a success, and we all need to work together. No one can afford to sit on the sidelines and refuse to be a part of the solution.'

As the partners who are spending more than anyone to be involved - something north of $10 million apiece for Chevrolet and Honda, and a lesser sum for Lotus - it won't be a surprise if the engine manufacturers volunteer to take the hit in order to ensure their greater investment pays off.

CONCLUSION

Provided the roots of what led the DW12 to miss its marks are thoroughly researched, documented and used to avoid similar problems with its future replacement, the short-term obstacles facing those involved with the 2012 Indy car should be nothing more than a historical footnote. On a positive note, after being conceived while IndyCar lacked a robust technical department, Phillips has now brought the checks and balances to the programme that were missing during the DW12's gestation period and this can only have benefits in the long term.

Though the problems are numerous, none are insurmountable and the solutions required are achievable before the 2012 season gets under way. That's not meant to diminish the workload for everyone involved with the DW12, nor should IndyCar let Dallara off the hook for delivering a car that met so few of its targets, but for now, Phillips has his team focused on the only thing that matters - fixing the cars so teams can conduct meaningful tests before the season opener at St Petersburg in March.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The Italian job

Budget single-seater set to catalyse new Italian cluster

BY SAMUEL COLLINS

When you think of the Italian motorsport industry, the area around Bologna is the first thing you think of, but that is not where Italy's newest constructor is to be found. Mirage Motor Company was only recently founded, opening its doors in September 2011, in the sleepy village of Spinetoli, just off the Adriatic coast, north of Pescara.

It's first product – the FM2K11 open-wheel racecar – appeared very quickly, only a month and a half after the company was founded, and made its debut at the PMW Expo in Cologne, Germany last November.

'We are an Italian company with a specialism in composites. Whilst we are new, we still have very strong experience. Our company owner has experience from Ferrari, Maserati, Piaggio Aprilia, as well as other famous Italian brands,' reveals Marco Pistillo, general manager at composite specialist, MPE. 'To speed up our development, we acquired the assets of the Novareggiani company, and we are working with very experienced partners, like Santa Barbara who specialise in precision machining.'

The new single seater looks at first glance rather rudimentary, with simple front and rear wings, but it is designed with a purpose and a customer in mind. 'It is an entry-level car aimed at being low cost. It is especially designed for inexperienced drivers and gentleman drivers looking to have fun.

'Because it is a small capacity, low level training series, we do not have advanced aero. The drivers are not looking for the tiny gains but the big learning steps. So the design is a balance between price, safety and technology, and the safety is that of F3 2011, for which we have passed the homologation crash tests. We have a unique patented steering column, which is collapsible also.'

The Mirage is powered by a 1.2-litre, LRM-tuned BMW engine producing 140bhp. 'We did not want to build a car that was too powerful for the rookie drivers, so we kept the output low. However, we can supply the car as just a rolling chassis and the design can easily be adapted for other engines.'

The transmission is a five-speed sequential unit from Sadev, mated to the engine via a 140mm clutch. Otherwise many of the components are made in the area and the manufacturing work is done locally. The electronic systems, for example, are supplied by Mektronik and the fuel cell by Aerosekur, just outside Rome. So aside from a German engine and French gearbox, this is a very Italian car, and its makers clearly hope that it is the catalyst that kicks off a new industry cluster further south than the traditional Italian motorsport valley.

The first tranche of FM2K11s will be used in the newly re-launched Formula Monza one-make series that runs on four tracks in Northern Italy, including the home of the Italian Grand Prix, which lends its name to the category. Mirage has plans to export the car overseas too, and hopes that its low price (29,000 euros / £24,250 / $37,900 for a rolling chassis) attracts buyers globally. Ten cars had been built at the time of writing, but more are under construction.

"an entry-level car aimed at being low cost"

TECH SPEC

Mirage FM2K11

Class: Formula Monza

Chassis: carbon fibre monocoque, crash tested to FIA F3 2011 specification

Engine: LRM-tuned BMW 1.2-litre, four cylinder, four butterflies, dry sump, 140mm single disc clutch

Max power: 120bhp at 7000rpm

Suspension: double wishbone with pushrod-actuated ORAM dampers, adjustable for bump and rebound; monoshock (front), twin shock (rear); 5in long, 36mm diameter springs

Brakes: Tarox six-piston calipers and steel discs

Transmission: Sadev SL66-14 five-speed sequential

Fuel tank: Aerosekur FIA FT3 25 litre

Electronics: Mectronik MKE1

Length: 2600mm

Track: 1445mm

Weight: 400kg

Power will come from a 1.2-litre BMW engine, with a Sadev sequential transmission. Everything else is made in Italy


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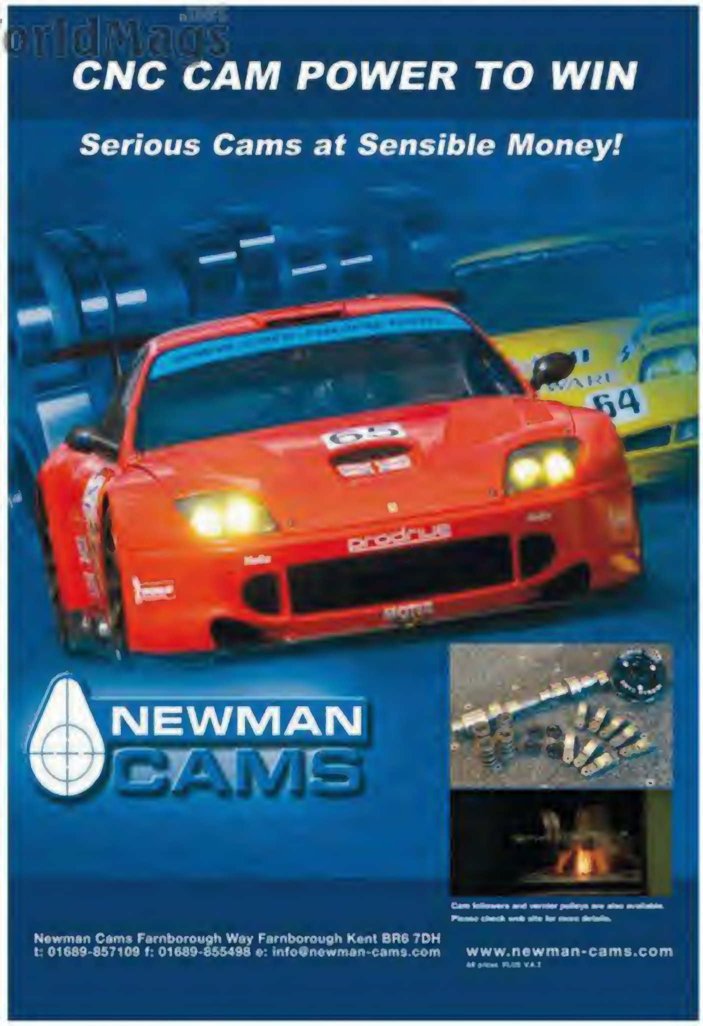
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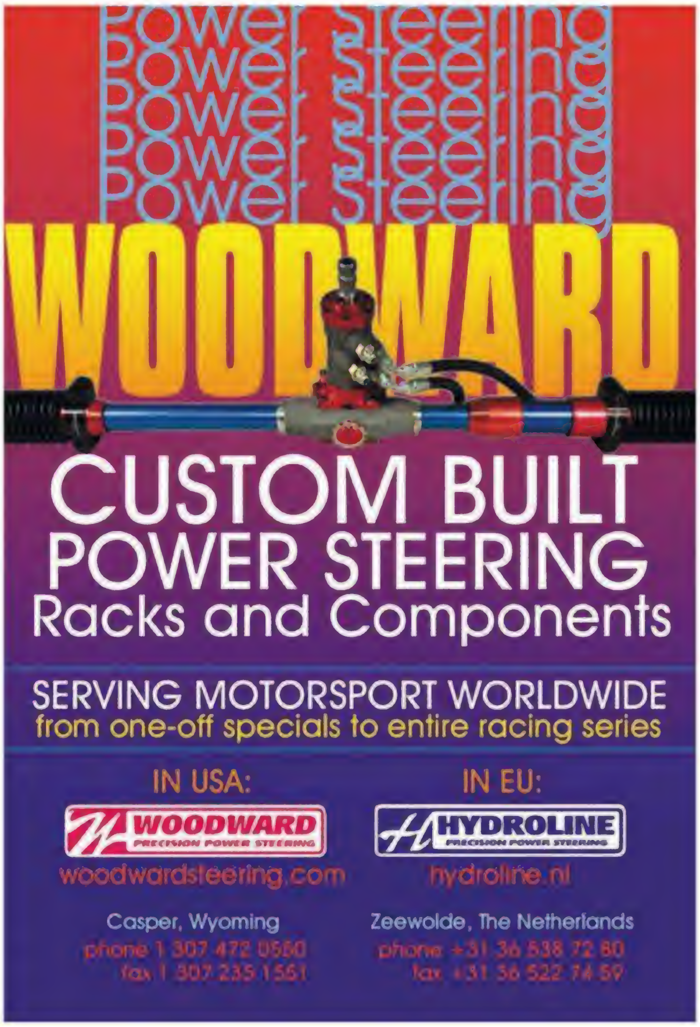
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Connecting the dots

How to turn racecar simulation into a useable tool

BY DANNY NOWLAN

Over the last month I've been on the road delivering seminars and training colleagues and customers in and out of the ChassisSim community. What has become apparent is that, while they are convinced of the worth of racecar simulation, they are not sure what it actually is and how to connect the dots so it becomes a useable tool. This is what I will be addressing here.

This article will be based around transient simulation, something for which I make no apologies. I have made clear in the past my thoughts on the benefits of transient simulation vs pseudo-static simulation but, even for those using the latter, what we are about to discuss is applicable to you, so read on.

First, let me re-iterate that racecar simulation is the ultimate motorsport calculator – transient simulation in particular. It is a fantastic tool to understand what is going on with the racecar and play 'what ifs?'. Let's illustrate this with a typical ChassisSim overlay, as shown in **figure 1.**

But let's first take one moment to review what we are seeing. We can see immediately that we have a representative environment that entails speed, steering and throttle and dampers, including bumps. This is so important because race teams at the upper end of the grid spend fortunes on seven-post rig replays for very good reason. But this is exactly what you are seeing in figure 1. This is only something I have really started to appreciate in the last couple of years, but it makes your time on the rig so incredibly valuable because it allows you to be much better prepared. If you are serious about going quickly, the information you see in figure 1 is absolutely vital. Also, if you do your modelling right, with this basis the lap times and the trends pop out as a consequence. This is what you have at your finger tips.

However, the question has to be asked – how do you get there?

The starting point is to measure up the racecar. While this might cound like stating the perfectly obvious, if you don't do this you might as well pack your bags and go home. I wrote an article a year ago on this subject, but let me present some highlights again here:

- **You will require a measuring pad to accurately measure the car. Ensure the pad is within a tolerance of +/-1mm from end to end. And, if it's an open wheeler / Sportscar, take the floor off**
- **Measure the suspension geometry**
- **Deduce the motion ratios**

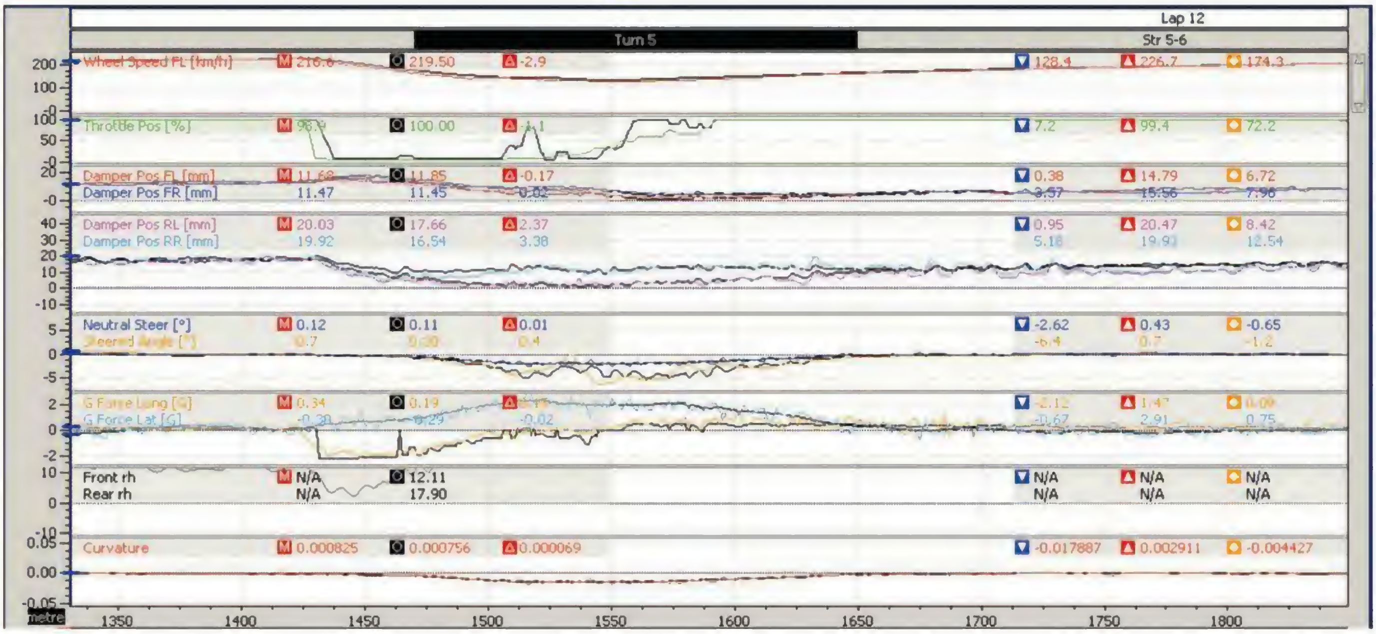


Figure 1: a typical Sportscar overlay

Above all else, take your time. It might annoy team managers and mechanics, but the good ones will readily assist.

When I am measuring suspension geometry, I use the sheet illustrated in **figure 2**. Using this, you will have everything you need to measure right there in front of you. You can also easily extend this to deal with bell cranks and damper locations, too. Always measure across the chassis to minimise measurement error, and run the numbers straight through your geometry package to ensure they make sense. It will take you longer, but it will be worthwhile.

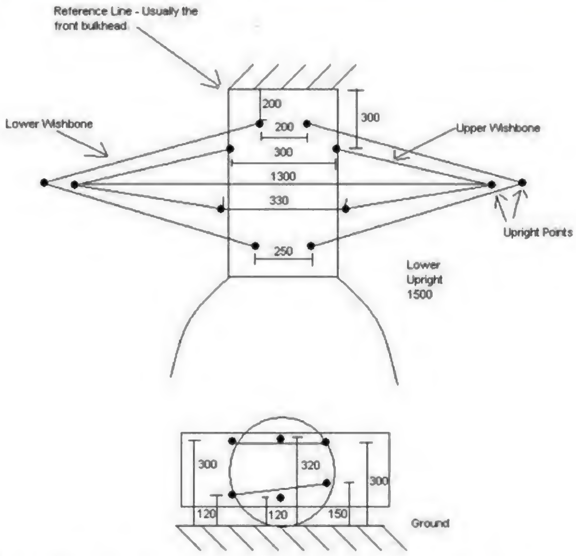


Figure 2: suspension geometry measurement sheet

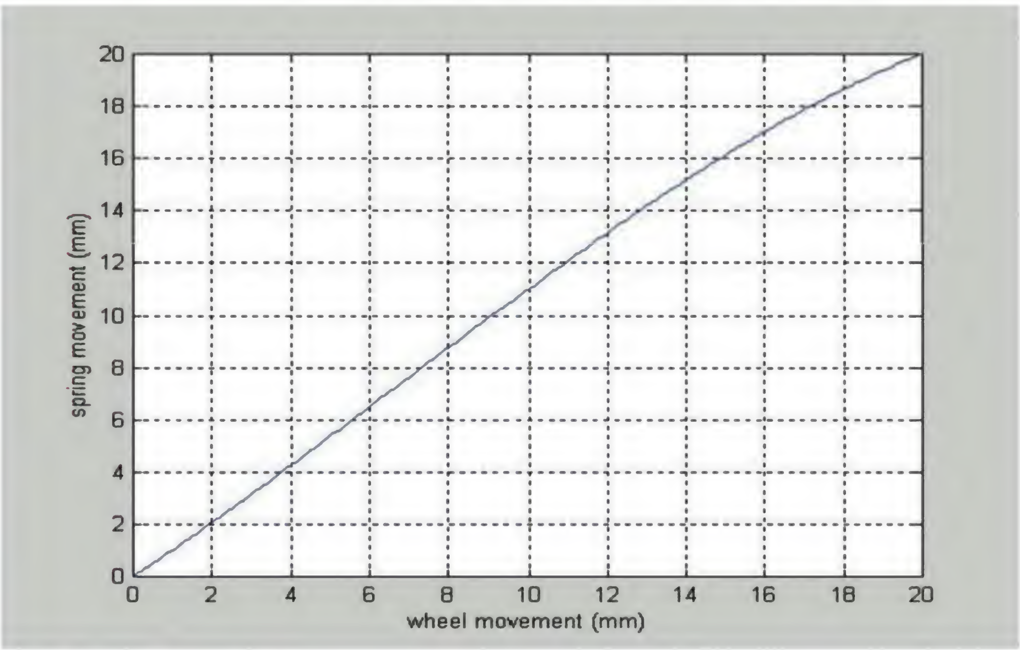


Fig-3 - Plotting motion ratios.

The other thing I would like to highlight here is the measurement of motion ratios. Even though suspension geometry programmes will happily calculate this for you, I strongly advocate measuring it yourself. The reason for this is it is such an important parameter and it can ruin your day if you get it wrong. So, to this end, I always advocate measuring damper / bar vs wheel displacement. When you have done all this, you should wind up with something like that shown in **figure 3**.

The key thing to note as you are measuring this up is to have something like Excel open and to plot it as you go. What you want to avoid is any inconsistencies or sudden spikes in the measured data. If you find you have any, this is your cue to re-measure the motion ratio.

Another matter I want to touch on is the situation when you have incomplete engine data. This is a bugbear, but one there are a few simple workarounds for:

- **Put the car on a rolling road dynamometer**
- **If you have only peak power and torque values, talk to an engine builder / tuner. I can speak from direct personal experience that they are very susceptible to flattery and nice wine / beer**

The key is to obtain something representative. While it is not

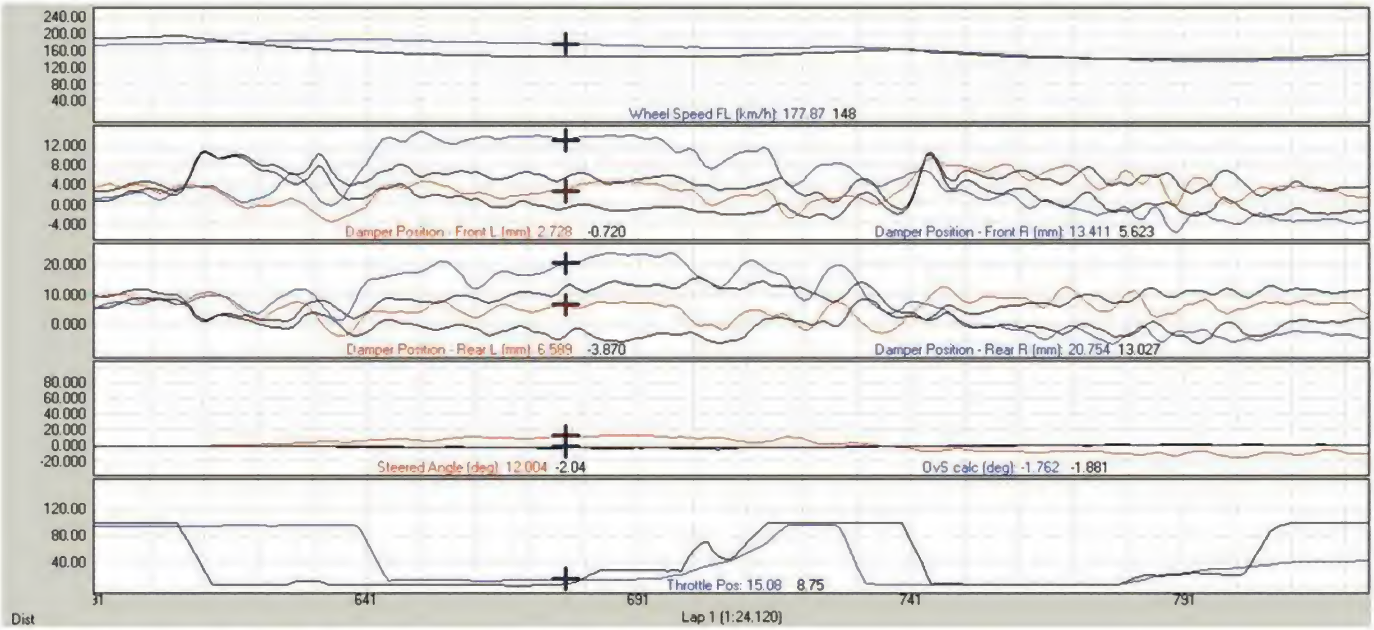


Figure 4: a comparison with an on-camber corner that hasn't been simulated

perfect it should get you within 10 per cent, and I can tell you from practical experience that this is good enough.

Lastly, I want to go through a general check list of what you need to tick off when putting your base set up for the sim:

- **Springs, bar rates**
- **Dampers - peak force vs peak velocity curves**
- **All bump rubber information and gaps**

The next step in the process is to get race data that matches your set up. Again, incredibly obvious, but so important. The things you want to focus on when getting the data ready are as follows:

- **Ensure the speed trace is smooth. When it comes to circuit creation, brake lock ups can ruin your day**
- **Ensure the longitudinal acceleration is related to the speed, don't just take it on face value**
- **Ensure the lateral acceleration and throttle sensor are behaving themselves**
- **Dampers - zero them on the ground, typically leaving / entering the pit lane**
- **Steering - this is the driver input calibrated at the tyre**

I call this creating the monster file. This contains the bulk of the information you need to validate your model.

Once we have the data, hand calculate the downforce at the fastest point in the circuit. This gives you a great picture of what the aero is doing. Also, if you don't have pitch sensitive data, set the aero map at these hand calc values for CLA, CDA and aero balance. It's not perfect but it gives you a very good start.

When you have the data and the set up, you are now ready to create a vehicle model. I strongly suggest you start from a model that most closely resembles your car and, slowly but surely, make the changes one at a time and test with a pre-loaded circuit. Doing it this way will ensure you don't make any mistakes. As I have mentioned before, you don't get extra points from starting from scratch, you get credit for a model that produces results.

Equations

1

$$iR_Z = iR_y \cdot \tan(\phi_{rc})$$

where,
iR_z = normal curvature
iR_y = inverse corner radius
ϕ_{rc} = road camber angle

2

$$GF = \left(\frac{V_{ACT}}{V_{SIM}}\right)^2$$

where,
GF = grip factor to apply
V_{act} = actual simulation speed
V_{SIM} = simulated speeds

THE CIRCUIT MODEL

When you have entered your model, the next step is to create the circuit model. A typical circuit model consists of the following:

- **Curvature file - this is the circuit trajectory. It is a plot of inverse corner radius vs distance**
- **Bump profile - this is the road surface trajectory**
- **Altitude / road camber file - this plots road camber and altitude**
- **Bump scale factors - local scaling factors for the bump profile**
- **Grip scale factors - again, local scaling factors**

I have deliberately listed the components in order of importance. The curvature and the bump profile are what you do first. This is critical because they are the two most important elements of what is going to dictate the grip on the circuit. We'll discuss how the other elements come into play shortly.

Now, log the curvature and bump profile to data and do an initial comparison. What you are interested in is the general speed trace. If the speeds are down in every corner, or greatly increased, this is your cue to adjust global grip factors. Remember, for a non-calibrated model, correlation of 3-4km/h is good enough. The next step is to look at the comparisons where the corner speeds have a differential of 10km/h or more. At this point you should be asking yourself the following questions:

- **What's the road camber / normal curvature here?**
- **What are the bumps inputs at this point?**

Only when you have asked these questions are you ready to play with local grip variation.

"make the changes one at a time and test with a pre-loaded circuit"

Let's now explore this in further detail. The reason road camber is so important is because of the effects the normal curvature will have on tyre load. Effectively, the normal curvature it causes can be described by **equation 1**.

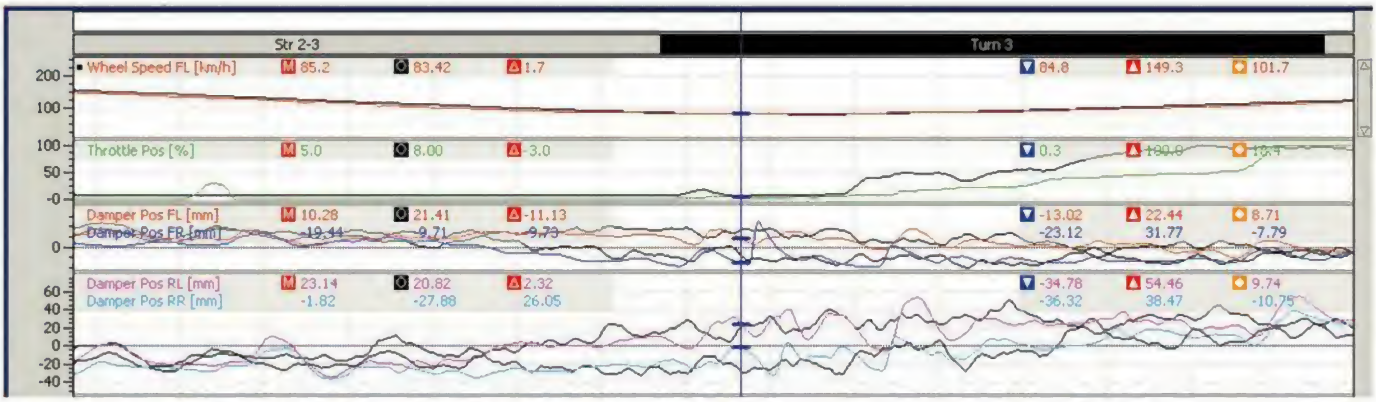


Figure 5: an example of when bump scale factors need to be applied

A graphic illustration of this is the Indianapolis Motor Speedway. I was always aware the track banking was approximately 9.2 degrees, yet the first time I saw it for real, I thought 'is that it?' Yet it is this relatively slight banking that allows high-downforce open wheelers to go flat out, and this is why it's so important. A tell tale sign that a corner is on camber is when you have a simulated vs real corner that looks like that shown in **figure 4**.

The first trace is speed, the second trace is the front dampers and the third trace is the rear dampers. The actual car is coloured, the simulation traces are black. What is immediately clear here is the actual car is squatting significantly more than the simulated car. This is an indication that more road camber has to be added to this corner.

However, most on / off camber corners can be very difficult to detect, yet their effects are still significant, so what do we do? The first method is to look at circuit surveying data. This provides a conclusive answer one way or the other. The other is if you have GPS data. Your fall back is either track walks or watching in-car camera footage using tools such as YouTube. While it's very subjective, there is nothing like a picture (or even better, a video) to illustrate what you are looking for. It saves an awful lot of second guessing and indicates what to aim for.

Once the road camber has been established, the next thing to look for is what the bumps are doing so that bump scale factors may be applied. What you are looking for is something like that shown in **figure 5**. As we can see here, the bump magnitudes (as illustrated in the second and third traces) are the same, yet the corner speed differential is in the order of 20km/h. When you see something like this, you apply bump scale factor. What you apply will depend on a case-by-case basis but, for something like that shown in figure 1, as a rough rule of thumb I'd be applying 70 per cent front and rear.

Once this is ready and there is still cornering differences, you then apply grip scale factor. Again, as a rough guide, **equation 2** applies for grip scale factors,

If you need to get to this point, then what you are applying are very small corrections (in the order of 10-20 per cent, if that). However, it's important to work through the other steps first because you don't want to miss any important information along the way. This is why there is no auto grip matching in ChassisSim. It may make you look like a hero, but in reality it can skip over many significant effects that can catch you out.

Also, in correlating your circuit model, you don't need to be accurate to the nearest 0.01km/h. You just need to be in the ballpark. At this point let me give you some further rough rules of thumb:

- **Un-calibrated model: 3-5km/h**
- **Calibrated model: 1-3km/h**

These will vary from case to case (particularly if you are investigating fine changes on ovals) but again, this will get you in the ballpark. One of the biggest mistakes I see people make using racecar simulation is they waste an inordinate amount

"The goal in aero modelling is to establish both a ride height sensitivity map and general downforce levels for your wing changes"

of time achieving the perfect correlation when, in reality, they should be focussing on ensuring the model is capturing what is going on with the racecar.

CAR MODELLING

Now that we have discussed how to model the circuit, let us now talk about what's involved with car modelling. This should be done in this order:

1. **Aero modelling – the aero loads play such a significant effect on tyre loads that this has to be done first**
2. **Tyre modelling – once you have done the aero loads, this will fall into place**

The goal in aero modelling is to establish both a ride height sensitivity map and general downforce levels for your wing changes. To begin, a unity aero map using the fastest point of a long straight forms a good start point. That being said, as a rule of thumb, if you have a CLA value greater than 1.5 and car masses less than, say, 1200kg then you need a pitch sensitivity map.

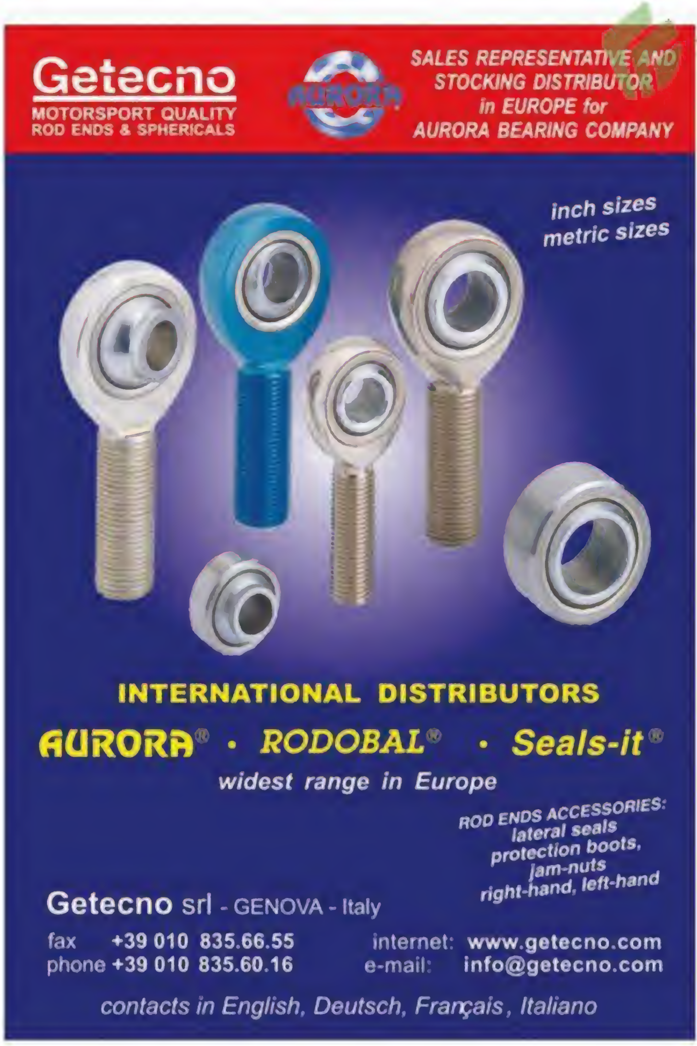
In terms of tyre modelling, the necessary ingredients are the car data, the curvature file, the bump profile and any bump scaling and the circuit altitude and road camber data. This information, plus the monster file, forms the basis of the ChassisSim tyre force modelling toolbox. Once you have these elements you are ready to do tyre modelling. To cover this in detail is beyond the scope of this article, but it will be an iterative process and the rewards are more than worth it.

So, in summary, our racecar simulation procedure is just a matter of going through a simple series of steps. These are:

- Measuring the car
- Entering the set up
- Creating a model from an existing model that closely resembles your car
- Creating a circuit model
- Refining the circuit model
- Aero modelling
- Tyre modelling

It's not rocket science, it's just a matter of connecting the dots. What's more, a lot of these steps are just extensions of what most racing organisations do, so all of this is well within reach.

In closing then, as we can see racecar simulation isn't hard, it's simply a matter of attention to detail and working through things sequentially. Once you learn to do this, racecar simulation will become a valuable tool because, as shown in figure 1, it gives you so much valuable information. And the great news is that all of this is well within reach of every motorsport professional / enthusiast.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Quaife launches heavy duty four-wheel drive transmission

Renowned performance transmission company, Quaife Engineering, will launch its QBE87G 4x4 sequential gearbox at Autosport International. Based on its highly successful QBE69G unit, the new transmission has been developed for all-wheel drive, high-powered motorsport and fast road cars of up to 750bhp.

Quaife's state-of-the-art sequential gearchange mechanism is incorporated, as well as an in-line transfer assembly with a choice of viscous coupling or Quaife ATB differentials. Seven different straight cut gear ratio sets or a helical gear set can be selected, with five different drop ratio sets also available, allowing the gearing to be tuned for a wide range of applications.

Quaife Engineering
Hall 9, stand E133
www.quaife.co.uk

Cruden demonstrates new software upgrades

The world's leading professional motion simulation company, Cruden, will demonstrate its new software updates during the show. Its new Set-Up Tool allows engineers to change vehicle settings, including shock absorbers, dampers, wing settings and throttle mapping, all while the simulator is in use.

Meanwhile, its new Telemetry Analyser facilitates the evaluation of vehicle model performance and driving style while the simulator is running or after the session. Its instant feedback allows for the analysis of lap and sector times, speed, throttle, brakes, steering angles and gears. Also added to Cruden's offering is a GPS tracker, which allows onlookers to view a simulated lap or race while seeing driving position, lap times and ranking.

Cruden
Hall 6, stand 6670
www.cruden.com

Roemheld five-axis vice to be demonstrated

Roemheld will have a range of its recently launched workholding solutions on display in Hall 9, stand E1125. This includes the Hilma KC100 five-axis vice, which has all the features of the SCS vice range, with the advantage of round carbine inserts, allowing concentric components to be gripped in the same vice.

Also on display is a new fast-closing, zero point mounting system that clicks into place and holds immediately. The Start Speedy easy click is a mechanical clamp that engages without the application of any force.

Roemheld
Hall 9, stand E1125
www.roemheld.co.uk

New moulding technology for wiring harnesses explained

Designer and manufacturer of bespoke wiring harnesses, Phoenix Dynamics, will discuss its low pressure moulding services in Hall 9, stand E1071. Following investment in new facilities, the company will illustrate its services, which allow for precise control of wiring junctions and the incorporation of clipping or mounting features to minimise weight and reduce components.

Phoenix Dynamics
Hall 9, stand E1071
www.phoenixdynamics.com

MIBA Coating Group makes show debut

Supplier of specialist coating solutions to the automotive industry, Miba Coating Group, will make its Autosport International debut at the show in January. The company, exhibiting in Hall 9, stand E1021, specialises in polymer, electro-plated and PVD coatings and the construction of coating equipment.

Miba Coating Group
Hall 9, stand E1021
www.miba.com

Samco Proshield titanium exhaust wrap on show

Samco is to display its new Proshield exhaust wrap, made from premium quality titanium fibre material, woven into a tight multi-flex construction for additional strength. The titanium wrap also offers greater heat resistance up to 1200degC.

Samco
Hall 7, stand 7552
www.samcosport.com

ELECTRONICS

Geartronics Easyshift

Paddle-shift specialist, Geartronics has introduced its 'Easyshift' stand alone, closed-loop, flat shift and auto-blip controller, which it believes to be the only aftermarket system to operate purely by monitoring an existing gear position sensor. This innovative system eliminates the requirement for load cells or switch mechanisms to detect gear lever movement. Instead, the engine torque reduction or throttle blip is initiated when the ECU detects a small change in the position of the rotary barrel position sensor. The system then constantly monitors the sensor to determine when it's safe to resume engine power, or when it's appropriate to turn off the throttle blip. Using closed-loop technology means there is no possibility of resuming engine power prematurely, with resulting gearbox damage. The system can operate in either stand alone mode or integrate with most aftermarket engine management systems. The company's owner, Neil Wallace, points out that the movement of the gear lever is pretty much irrelevant, and that the barrel position is all that really matters. 'We, along with many others, have experimented in the past with micro-switches and proximity sensors to detect movement of the lever,' explains Wallace, 'but invariably found them difficult to set up and temperamental in use, leading to compromised reliability.'

Geartronics will be on stand E455, where interactive demonstrations of their products can be seen.

ELECTRONICS

Phoenix Dynamics wiring

Phoenix Dynamics has enhanced its services to the motorsport sector, following an investment in a low-pressure moulding facility, allowing it to produce complex, rugged wiring harnesses in low production runs. Using this moulding technique, Phoenix Dynamics can now create bespoke junction shapes to suit specific routing or installation requirements and provide mechanical reinforcement to protect components from exposure to shock, vibration, moisture and other potentially race threatening issues.

This offers a real alternative to traditional heat shrink boots, with the major advantage of moulded joints being that it makes it possible to create any size, number or orientation of harness branches, making it ideal for complicated harness layouts and constructions. The relatively low cost nature of the required tooling also allows changes to be made as a race season progresses.

'The precision moulding of wiring harness junctions is bringing added flexibility to designers of wiring systems as we can now provide them with the potential to design bespoke shapes to allow specific routing or installation to be achieved, while at the same time adding additional ruggedisation to the harness itself. Of importance to the motorsport sector is the elimination of additional components and the associated reduction in weight of the wiring harness,' said Carl Kirk, company sales manager.

See Phoenix Dynamics on stand E1071

HARDWARE

Lifeline Zero 360 upgrade

UK-based extinguisher systems specialist, Lifeline, has launched a newly evolved version of its Zero 360 fire suppression system. It uses the company's unique compression discharge technology, which deploys pure 3M Novec 1320 extinguishant in a constant spray pattern, but this version mounts directly to the vehicle, adding strength to the unit and making installation easier. The new system uses interchangeable operating heads – from mechanical to electrical – which can be added by the supplying dealer. Simplified plug 'n' play electrical wiring connections complete the upgrades. 'We are constantly evolving, adapting and adding to our product range through an ongoing research and development programme,' says Lifeline Managing Director, Jim Morris. 'The benefit to our motorsport customers is that we are continually improving the safety envelope of their drivers, as this new Zero 360 demonstrates.'

The Zero 360 fire suppressant system is available in 2.25 or 3kg versions and is suitable for use in all forms of motorsport.

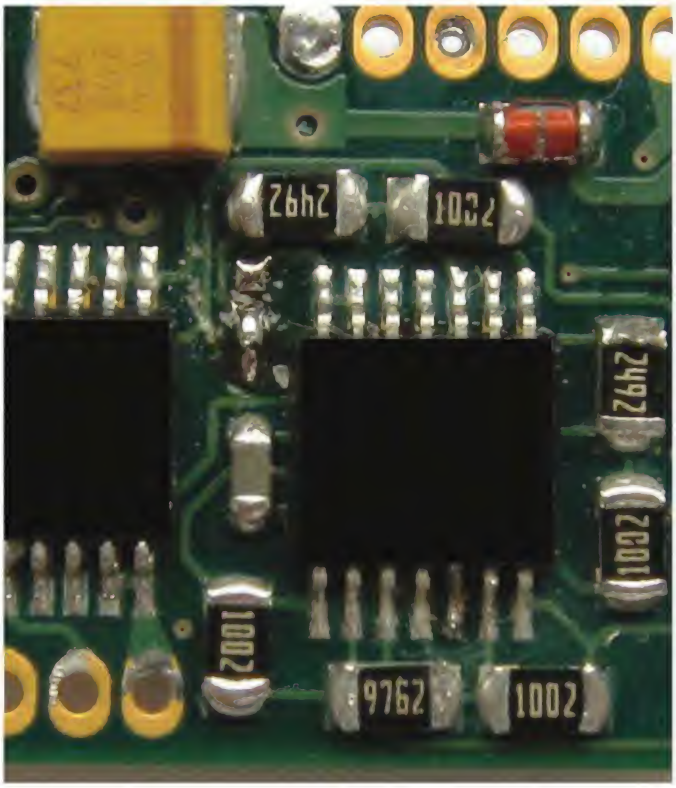
For more information see lifeline at Autosport International on stand E256

OGP SmartScope CNC 670

OGP, a UK-based supplier of coordinate measuring machines (CMMs) for smart metrology, has launched the CNC 670 multi-sensor smartscope system in the UK and Europe. The new machine is the biggest in the company's range to date, and its impressive XYZ range means that it is even capable of measuring components as large as an automotive engine block. Despite its remarkable size, the intelligent use of space in the mechanical design of the system means it retains a relatively small footprint.

The CNC 670 is fitted with a large magnification, 12:1 range zoom lens that calibrates itself automatically after each magnification change. It also features a stable granite bridge that provides metrological stability across the entire X axis, while dual Y axis scales assure high accuracy and repeatability. The DC motor and drive package provides XY travel of 200mm/sec. As a result, the system is able to produce accurate and repeatable measurements in a short space of time and within the constraints created by the manufacturing workflow. LED illumination, including green back light, white coaxial TTL surface light and OGP patented programmable SmartRing lights, means the CNC 670 can address most lighting needs with ease. Optional measurement software provides 3D capability with full sensor and rotary integration.

bf1systems dual gain intelliamp



Bf1systems has announced that its dual gain intelligent amplifier was undergoing testing in the F1 young driver test at Abu Dhabi's Yas Marina race circuit. The new intelligent amplifier ('intelliamp') allows F1 teams to analyse dynamic loading and aero balance data from a single strain gauge installation on each pull and push rod. Bf1systems was approached by a team who wanted to analyse both dynamic loading (high loading) and aerodynamic balance (low loading) from a single suspension part.

A commonly used solution to achieve this involves adding a second strain gauge, with a separate higher gain amplifier being added for the aero balance analysis. Bf1systems' design team opted to re-design its intelliamp to incorporate two separate 0-5V outputs with individually scaleable gains and offset. In addition to providing two separate outputs, the new amplifier also incorporates bf1systems' microprocessor-controlled temperature compensation to ensure the part's outputs are unaffected by changes in ambient temperature. The intelliamp can compensate for changes in temperature from 10degC-125degC, with multiple parts all containing calibration tables to ensure common outputs. This removes the requirement to enter part-specific calibrations into the logger when components are changed.

The amplifier also incorporates a filter stage with a two-pole, low-pass Butterworth filter, which can have its cut-off frequency configured at build time. Despite the addition of extra components in comparison to the single channel intelliamp, the dual gain amplifier retains a small form factor of 15 x 18 x 5mm, ensuring that it can still be mounted directly onto the push or pull rod. The close proximity of the electronics to the strain gauging ensures that signal noise is kept to a minimum.

The dual gain intelligent amplifier will be just one of the new products bf1systems is showcasing at Autosport International, where they can be found on stand E353

List of exhibitors and stand numbers

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Advanced Fuel	E773
AEL Powertrain Solutions	E967
Aerocatch	E669
Aerocom Metals Limited	E871
Aeromotive Inc	E854
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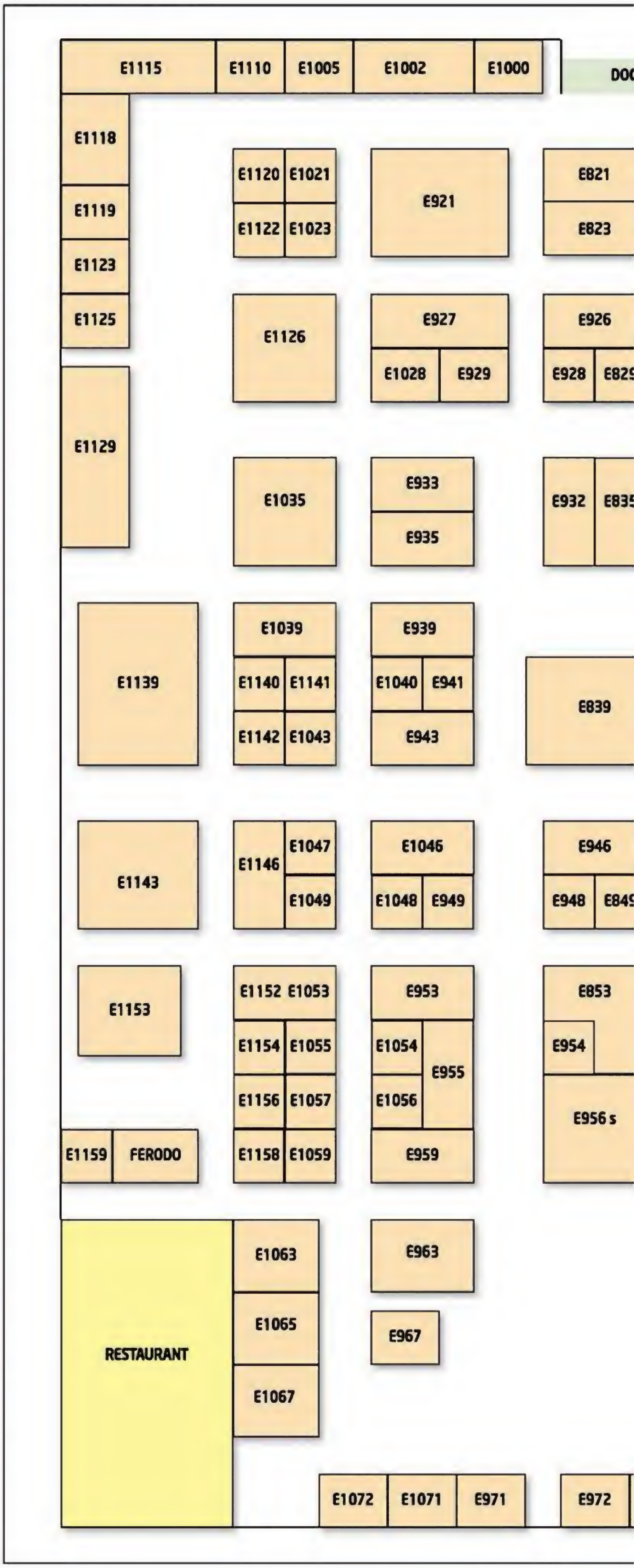

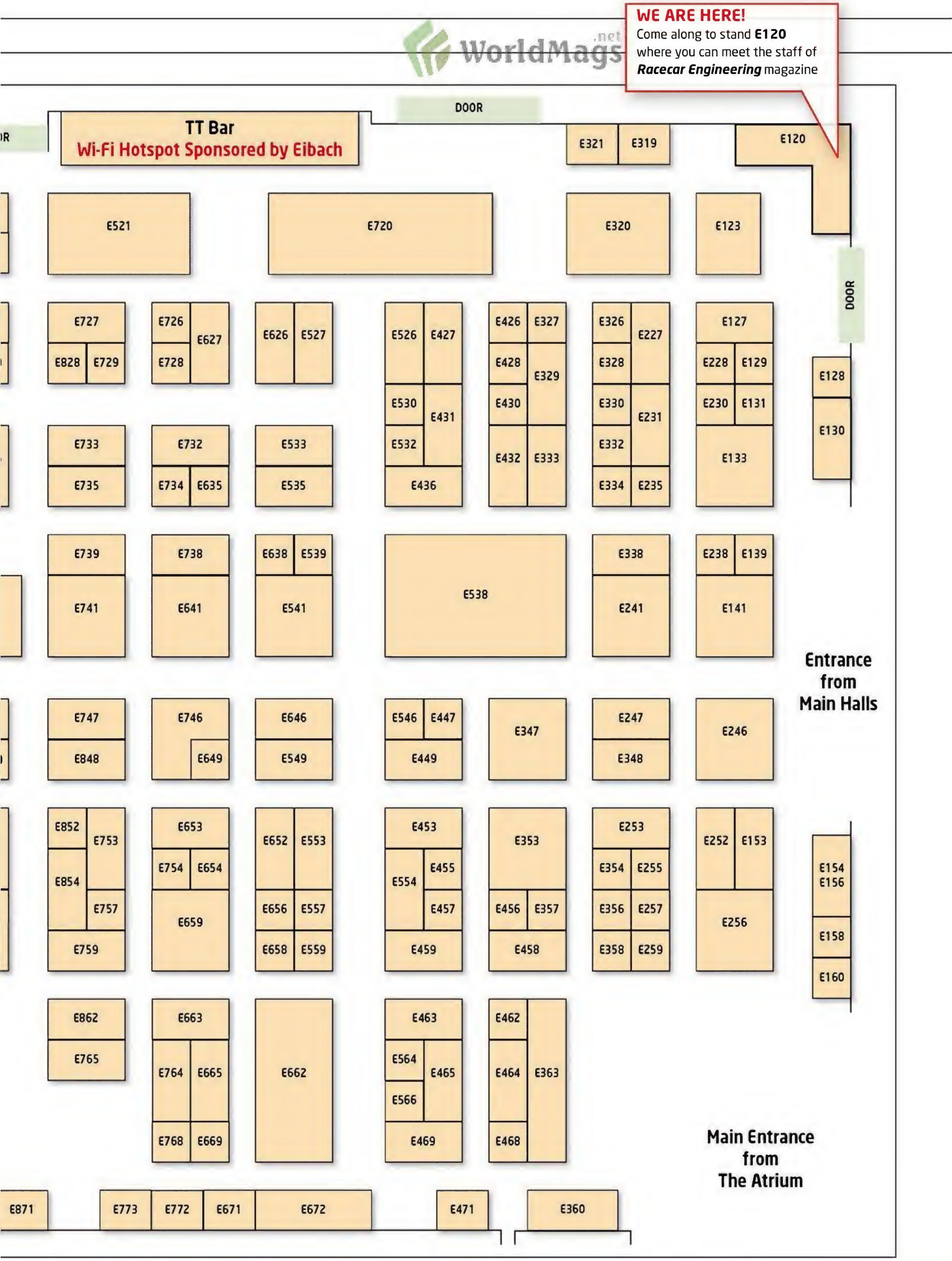
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Honda and Lola join *Racecar Engineering* in Birmingham

Very few privateers get the chance to own and race an ex-Formula 1 car, let alone one as recent as a 2007 chassis

Racecar Engineering will have a unique open-wheel car on its stand at the 2012 Autosport Engineering Show. Late in 2010, club racers, Bjorn Arnils and Nadine Geary, acquired a 2007 Honda F1 rolling chassis. RA107-5 already had quite a history as it was raced by Rubens Barrichello in the last 12 races in the 2007 Formula 1 season, starting with the Canadian GP, and clocked up over 8000 racing kilometres. It was then used for winter testing. After that the chassis went on loan to Super Aguri and ran as the Super Aguri SA08, before being returned to Honda. The chassis was then decommissioned and set up as a simulator by Brawn GP, who subsequently sold it to one of its employees.

The car was in far from running condition when Arnils and Geary acquired it, but they were determined to return the car to the track. The problem was that they lacked the 2.4-litre Honda RA807E engine, and the budget for the large team running a modern F1 car requires.

'Honda retained the factory steering wheel and engine but, apart from this, the car is remarkably original,' explains Geary. 'The original gearbox internals will be replaced with Hewland parts, but it retains its original carbon / titanium composite casing. The new engine will be a much more manageable 3.0-litre Hartley H1 V8, which will produce 500bhp and 280ft.lb of torque at 12,500rpm. When restored, the plans are to race the car in various monoposto series, including BOSS GP, and hoping not to scare ourselves silly in the process!'

You can see the unique project on the *Racecar Engineering* stand **(E120)**, along with Lola's latest Sports Prototype. Why not drop by and sign up for a subscription, or just come and meet the editorial team and tell them what you think of the magazine.

Joining the ex-Honda F1 car on the *Racecar Engineering* stand will be Lola's LMP1 chassis

TECH SPEC

RA107-05

Construction: moulded carbon fibre and honeycomb composite structure that surpasses latest FIA impact and strength regulations

Front suspension: wishbone and pushrod-activated torsion springs and rockers; mechanical anti-roll bar

Rear suspension: wishbone and pushrod-activated torsion springs and rockers; mechanical anti-roll bar

Dampers: Showa

Wheels: BBS forged magnesium front: 312mm wide rear: 340mm wide

Brakes: AP Racing, two six-piston calipers front and rear

Brake discs / pads: carbon / carbon

Steering: Honda F1 power-assisted rack and pinion

Steering wheel: DTA GP2, carbon fibre construction

Driver's seat: anatomically-formed carbon composite

Seat belts: Takata six-point harness (75mm shoulder straps with HANS)

Fuel cell: ATL kevlar-reinforced rubber bladder

Fuel capacity: 150 litre

Battery: 3Ah lead acid

Engine: 3.0-litre Hartley H1 V8 (replaces the original 2.4-litre Honda RA807E)

Gearbox: carbon composite maincase; six-speed unit; Hewland internals (originally the car had delicate Honda seven-speed, semi-automatic, hydraulically-activated internals)

Gear selection: sequential - pneumatic paddle shift activation

Clutch: carbon plate

Overall length: 4700mm

Overall height: 950mm

Overall width: 1800mm

Current owners: Bjorn Arnils and Nadine Geary


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Teams' association torn apart as two top threaten to quit

The Formula One Teams' Association, FOTA, was in disarray as *Racecar Engineering* went to press, following the announcements that three of its member teams, including front-running outfits Ferrari and Red Bull, intended to quit the organisation.

Red Bull, Ferrari and Sauber all announced they were leaving FOTA and, at the time of writing, Toro Rosso was also expected to announce its intention to leave, having failed to send a representative to a FOTA meeting set up to discuss the situation.

The teams will not actually quit until February, so, as of now, have merely given notice of departure, but this will ultimately mean that five of the 12 teams in Formula 1 (HRT left the organisation in 2010) will no longer be part of the association. FOTA was set up in 2009 to give the teams a collective voice in Formula 1 negotiations.

There is no stated clear reason why the teams wish to quit, but recently there has been discord within the FOTA ranks over the Resource Restriction Agreement (RRA).

However, both Ferrari and Red Bull insist they are still serious about controlling costs in F1. Ferrari said as it announced its intention to quit the organisation: 'Ferrari will continue to work with the other teams to make the current RRA, aimed at controlling costs, more effective and efficient, modifying it to make it more stringent in key areas such as aerodynamics, to re-balance some aspects such as testing and to expand it to areas currently not covered such as engines.'

"both Ferrari and Red Bull insist they are serious about controlling costs"

It's now widely believed that the top four teams – Ferrari, Red Bull, McLaren and Mercedes – are to hammer out a new RRA agreement between themselves, something which Red Bull team principal, Christian Horner, hinted at in Brazil: 'We met this morning and it has been decided that the RRA has effectively been taken out of FOTA for the time being, to try and achieve a solution,' Horner said. 'I think an RRA is important for Formula 1 and I think all the teams are unanimous on that. The thing that isn't quite clear is how to achieve it in a way that fits everybody's business models. Some of the teams are different, and I think the key thing for us is that the treatment and transparency of it is consistent and obvious and probably needs to go beyond the chassis and incorporate the engine as well.'

As the teams are bound into FOTA until February, there is a possibility that they will be persuaded to stay. There is also a possibility that the announcements are simply politically motivated bluffs, noting that Ferrari supplies both Sauber and Toro Rosso with engines, while the latter is also the sister outfit of Red Bull.

A weakened teams' association is sure to suit F1 commercial rights holders, Bernie Ecclestone, and CVC Capital Partners as negotiations for a new Concorde Agreement get closer. The tripartite agreement between CVC, the FIA and the teams is due for renewal in 2013 and talks between all parties are set to begin in earnest this year.

Red Bull and Ferrari have announced their intention to pull out of FOTA, as has Ferrari-backed team Sauber, while Torro Rosso is expected to follow suit

WRC receives support from FIA and Ford as backer goes broke

Ford received the assurances that it needed, and confirmed its commitment to the WRC to the end of the 2013 season

The FIA has said it is working on a plan to make sure the 2012 World Rally Championship goes ahead, in the wake of the news that the parent company of the WRC's rights holder has gone into administration.

Convers Sports Initiatives (CSI), which owns North One – the company that controls the WRC's media rights – went into administration at the end of 2011 after its boss, Vladimir Antonov, was arrested and bailed in London following the collapse of Bankas Snoras in Lithuania.

The news came as a body blow to the WRC, as CSI recently announced a multi-million euro, three-year plan to boost the Championship. 'The World Motor Sport Council discussed the recent developments involving the championship promoter... and its parent company... which has gone into administration,' read a statement from the FIA. 'The FIA is committed to ensuring the long-term commercial future of the championship and will make every endeavour to provide for its future stability.

'The FIA is working on an immediate plan to ensure the fundamental sporting and safety elements will be in place for the start of the 2012 season.'

North One put out the following clarification: 'In response to today's announcement... North One Sport would like to categorically confirm that the business is a stand-alone subsidiary and is not in administration. The priority is to ensure that North One Sport continues to successfully promote the WRC to fans, stakeholders and partners.'

Ford, meanwhile, confirmed its commitment to the WRC until the end of 2013. The Ford World Rally Team will be run by M-Sport in the UK. 'We feel that the timing for our announcement is right,' said Gerad Quinn, Ford of Europe's senior manager for motorsport. 'We had to be confident about the stability of the championship and to ensure it continues to provide great value and increased exposure globally. We discussed it with our stakeholders and, after receiving assurances, we look forward to focussing on competition once again.'

FIA technical delegate, Gabriele Cadringher, switches to Grand-Am

Gabriele Cadringher, known in Europe for his work as technical delegate for the FIA in Formula 1, will move to the Grand-Am offices in Daytona, Florida, and will become the chief technical consultant to Grand-Am Road Racing in 2012.

Cadringher will work closely with managing director of racing operations, Mark Raffauf, and the Grand-Am competition department to support implementation of new engineering-based initiatives, including aerodynamics, engine and turbo technologies.

Gabriele Cadringher

'Throughout his career, Cadringher has been at the cutting edge of new technologies,' said Grand-Am president, Tim Bledsoe. 'He has enormous credibility worldwide and will be an excellent ambassador for Grand-Am as we continue to enhance our series on the world stage.'

After working as an aircraft engineer, Cadringher joined the FIA in 1982 as director of the technical department and president of the Technical and Homologation Commission. He was also technical delegate for the FIA Formula 1 World Championship for 10 years.

He became president of the FIA Manufacturers' Commission in 1993, representing car manufacturers on the World Council. This role included constant liaison with manufacturers looking to introduce new technologies into motorsports, a role that required high level negotiation skills to unite often disparate interests.

'Grand-Am, together with NASCAR, is one of the great organisations in American motorsports,' Cadringher said. 'I'm honoured and looking forward to the new challenge and opportunity. I'm happy to take my experience to Grand-Am, where I can learn and gain in my appreciation of the American way of motorsports.'

BRIEFLY

ASNU wins award

UK-based company ASNU, the manufacturer of the ASNU Fuel Injector Testing and Servicing System, recently won two awards at the SEMA Show in Las Vegas, including Best New Product – Racing and Performance. ASNU md, Phil Ellisdon, designed a new high performance injector and controller that uses one core injector that can be altered with more than 15 different purpose-built adapters enabling fuel quantity, spray pattern and atomisation to be precisely controlled by tuners.

Regulation issue

The FIA's World Council has made a number of amendments to the sporting and technical regulations for the 2012 F1 season. Among the changes is a requirement for a car to pass all the mandatory crash tests before it's allowed to take part in winter testing, while there will also be a new upward push-off side impact test. There is also to be a maximum race time of four hours and a three-day test mid-season.

McLaren Honda?

Respected German motorsport publication, *Auto Motor und Sport*, recently reported that Honda may be considering a move back into F1 as an engine supplier to the McLaren team. McLaren currently use Mercedes powerplants, but is thought to be looking for a more exclusive engine deal. Honda quit F1 as a manufacturer at the end of 2008, but it may well be lured back by the prospect of producing its favoured V6 turbo units, due to be brought into F1 in 2014.

Austin powers

The 2012 Formula 1 calendar has been confirmed, with the 20-race schedule including both the US race in Austin, Texas, and the Bahrain GP. The 2012 season kicks off in Australia on 18 March.

Ansys HPC aids Red Bull development

The engineering simulation and HPC (high-performance computing) systems developed by US company Ansys have been vital in the successful development of Red Bull's 2011 RB7 racecar. Using these facilities, the Red Bull Racing team continually and quickly optimised its car design in a virtual testing environment on the team's suite of multi-core computer clusters. The insights gained gave them a decisive speed advantage on track.

While fluid dynamics simulation technology is widely used to predict and manage airflows around F1 cars to increase performance, time restrictions placed on all teams require quick, reliable and efficient simulations that maintain a high degree of accuracy. As a long-term user of ANSYS high-performance computing solutions, Red Bull Racing has benefited from recent technology advances. High-speed processors and related technologies are engaged to solve computationally-intensive problems. Because ANSYS delivers significant HPC enhancements with each new release, the Red Bull Racing team is able to solve not only many more smaller models within the same time period, but also to more quickly solve full-car models that contain hundreds of millions of cells. 'ANSYS HPC technology has ensured that we can test and implement changes quickly and competitively,' said Nathan Sykes, CFD team leader at Red Bull Racing. 'This allows us to turn around simulation results for multiple designs between race qualifications on Fridays and Saturdays, and give our aerodynamics team the important and reliable evidence they need to base vital engineering decisions for the final races on Sunday.' With the level of F1 competition fierce on and off the track, engineering teams race to develop their cars as quickly as possible. 'To retain freedom to innovate and adapt the car quickly, we rely on a robust modelling process. This puts new designs on the track quickly.

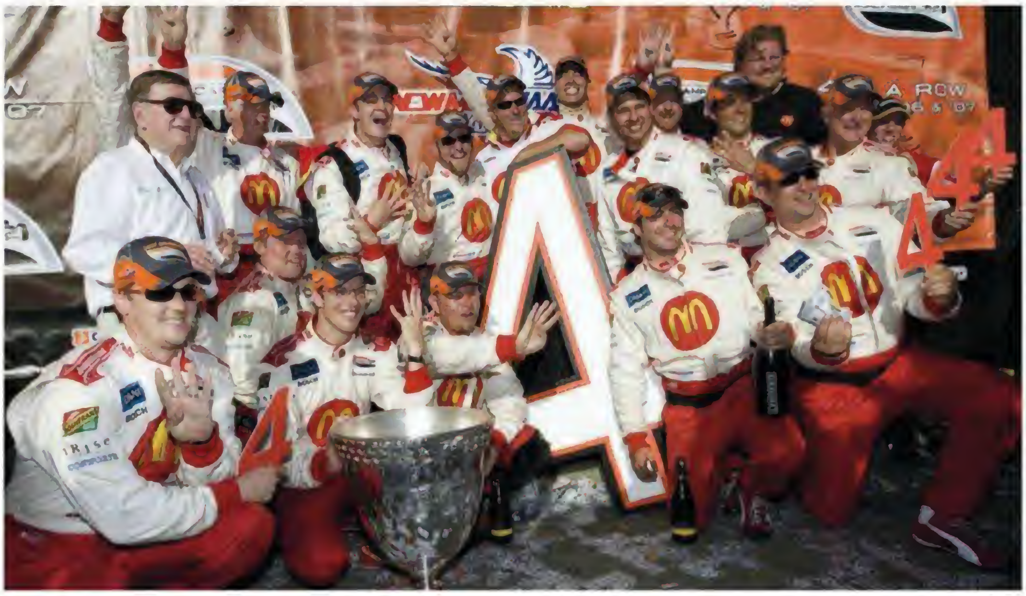
Newman / Haas quits Indy for 2012

Newman / Haas racing, one of the USA's most successful and best known single seater race teams, will not compete in the IndyCar series in 2012, stating that it is unable to operate in the current financial climate.

The team, which has been in IndyCar since the reunification of the two top US single seater championships in 2008, guided Oriol Servia to fourth place in the 2011 championship and James Hinchcliffe to rookie of the year, but has never reached the heights it did in its CART / ChampCar years. Team owner, Carl Haas, said: 'The economic climate no longer enables Newman / Haas Racing to participate in open-wheel racing at this time.'

However, the team will not be closing and, while it's been reported that it has laid off half its workforce as a result of the decision, it is believed to be looking at competing in other championships, including Sportscars and, despite Haas' quote, possibly single seaters, too. But it is thought to be highly unlikely that the team will switch to NASCAR.

Newman / Haas was founded by Carl Haas and the actor and motorsport enthusiast, Paul Newman, in 1983 and was the dominant force in the last years of ChampCar, securing four consecutive titles with driver Sebastien Bourdais between 2004 and 2007.



Sebastien Bourdais celebrates his fourth ChampCar title in the Newman / Haas glory days between 2004 and 2007

Lola target new generation of engineering talent

UK engineering company, Lola Group, is specifically targeting the next generation of engineers as it continues to build on its legacy as a market leader in high-tech manufacturing.

The composites technology company, which has a well-established reputation as a supplier of products in UK motorsport, aerospace, defence, communications, renewables and automotive industries, recently hosted an 'Employment Open Day' at its facilities in Huntingdon, Cambridgeshire. The event attracted 255 interested future employees, consisting of many young engineers eager to work for the company. The company has also placed a special emphasis on attracting young female engineers. Currently, only nine per cent of UK engineering professionals are women, with the UK falling significantly behind the rest of Europe. Lola Group is looking to continue the expansion of its workforce of 170 (up from 151 in 2010), having recently expanded its graduate placement and apprenticeship schemes, taking on 10 new recruits in 2011. However, like many other businesses in the UK, Lola is keen for the government to reduce the bureaucracy surrounding the employment laws that currently exist.

Lola's employment drive follows UK Prime Minister, David Cameron's, call to 're-balance the economy so that Britain makes things again' with 'high-skilled, high-value manufacturing and engineering [being] a central part of our long term future.'

Robin Brundle, managing director of Lola Group, said; 'Our Employment Day has been a tremendous success and demonstrated that there is a great deal of hunger and talent amongst Britain's young engineers. The Prime Minister has rightly called for manufacturing to lead the UK out of recession. We have a fantastic heritage in this sector in the UK and today has proved the future is extremely bright.'

RACE MOVES

David Malone is the new chief executive officer for V8 Supercars, Australia's top motor racing category. Malone takes on the position vacated by Martin Whitaker, who took up the new role of international director in the autumn of last year. Malone was previously CEO at Australian sports broadcaster, Premier Media Group.

Steve Addington is the new crew chief for 2011 NASCAR Sprint Cup champion, Tony Stewart, replacing Darian Grubb in the position at Stewart Haas. Addington has previously worked at Penske and Joe Gibbs Racing.

Luca Furbatto, who has worked at McLaren for the past 10 years, has now joined Torro Rosso, where he will be a part of the design team at the F1 team's Faenza base. Furbatto will take over from Ben Butler as chief designer in April, while Butler will return to Red Bull Technology in Milton Keynes.

Former Williams head of aerodynamics, Jon Tomlinson, has joined Scuderia Toro Rosso's wind tunnel staff at Bicester, taking

Jon Tomlinson

LAT

up the post of deputy head of aerodynamics and reporting to Nicolo Petrucci.

Drew Blickensderfer has joined Richard Childress Racing to work as crew chief for Jeff Burton in the NASCAR Sprint Cup. Blickensderfer has spent the past 10 years working for Roush Fenway Racing in NASCAR, and was crew chief for David Ragan in 2011.

Patrick Head will no longer travel to F1 races with Williams in an official capacity, having stepped down from his role as director of engineering to concentrate on the company's burgeoning hybrid business. Head, who is 65, has been with the team since it was set up in 1977.

John Iley is to join the Caterham F1 team (formerly known as Lotus) as its performance director in June this year, where he will head up all aerodynamics and CFD for the team, re-forming the successful partnership he previously enjoyed with Mike Gascoyne at Jordan and Renault F1. The aerodynamics wizard re-joined McLaren from Ferrari at the start of the 2010 season, and is currently on gardening leave.

It's thought that Dave Ryan could return to Formula 1 with Renault - now known as Lotus. Ryan was formerly sporting director at McLaren, but left the team after

Dave Ryan

LAT

the Lewis Hamilton row at the 2009 Australian Grand Prix. Ryan attended the Brazilian GP as a consultant to Genii Capital, the Renault team's owner.

Richard Childress Racing has made changes to its competition department as the NASCAR Sprint Cup outfit gears up for the 2012 season. Shane Wilson is now to be crew chief on the no 29 Chevrolet driven by Kevin Harvick, while Gil Martin - the no 29 crew chief since 2009 - has now been promoted to director of team operations, reporting to director of competitions, Kent Day.

Chris Heroy is now crew chief for Juan Montoya at the Earnhardt Ganassi Racing with Felix Sabates NASCAR Sprint Cup outfit. Heroy joins EGR from Hendrick Motorsports, where he has worked since 2004, mostly as lead engineer on the no 5 car. Before starting his NASCAR career, Heroy was an engineer in Toyota Atlantic.

Brian Pattie is now crew chief for Clint Bowyer in the NASCAR Sprint Cup. Pattie comes to the Michael Waltrip Racing Toyota after a long career in the Nationwide Series, where he scored 18 wins, and two seasons tending the car of Juan Montoya in the Sprint Cup at Earnhardt Ganassi Racing.

Dave Mitchell, vice president at NASCAR Nationwide team, Rick Ware Racing, died unexpectedly at home in late November. Mitchell,

McLaren becomes first carbon neutral F1 team

The McLaren Mercedes F1 team has been certified by Carbon Neutral Investments (CNI) as 100% carbon neutral, becoming the world's first carbon neutral Formula 1 team. The team has worked alongside CNI to select appropriate and relevant initiatives to offset the team's carbon footprint.

Team principal, Martin Whitmarsh, said: 'This announcement is the strongest possible proof that we've gone farther than any other Formula 1 team in becoming more environmentally sympathetic and efficient - an achievement that's of great importance not only to our organisation but to all our partners too.'

In addition to carbon offsetting with CNI, McLaren has implemented a series of efficiency-driven measures to reduce CO_2 emissions 'at source' within the McLaren Technology Centre - where annual savings of more than 1500 tonnes of CO_2 emissions have been achieved. CNI co-chairman, James Brown, said: 'Vodafone McLaren Mercedes leads the way across Formula 1, and certainly does so in terms of environmental initiatives: the first F1 team to achieve the Carbon Trust Standard, recognition by the Government's Carbon Reduction Commitment Energy Efficiency Scheme and a whole host of initiatives at the McLaren Technology Centre.'

The carbon offsetting projects selected by Vodafone McLaren Mercedes with CNI provide a perfect fit with the team's core business ideology and ethics. Two hydroelectric initiatives in India and Brazil have been selected, chosen for their prominence on the current Formula 1 landscape and also their employment of technical solutions that bring considerable value to local communities.

ATL supply BTCC

UK based fuel cell specialist ATL has been selected as the sole supplier to the DTM and BTCC championships in 2012. ATL has worked with the organisers of both championships to design a spec fuel cell for each series.

The cell for the British Touring Car Championship is composed of a Nylon-reinforced fabric with a hard-wearing synthetic elastomer coating. The bladder features a sump with integral collector for uninterrupted fuel pick-up, while the fuel pump, pressure regulator and filter are all mounted on the inside of the cell - all plumbed together with spanner-less, connections. The DTM cell uses Kevlar as its reinforcing fabric. For this application, the company has designed a sophisticated internal plumbing system, which uses four low-pressure pumps to feed an enclosed internal collector - ensuring that the main high-pressure pumps are never starved of fuel. Two high-pressure fuel pumps are plumbed in series and mounted inside the fuel cell, with the fuel filter mounted on the outside of the coverplate. Another innovation is the use of a 'removal pull-tab' securely fixed to the inside rear of the fuel cell.

CAUGHT

Tony Eury jr, the crew chief for the JR Motorsports no 7 Chevrolet that competes in the NASCAR Nationwide Series, has been fined and placed on probation until the end of March for running with an improperly attached weight at Phoenix International Raceway.

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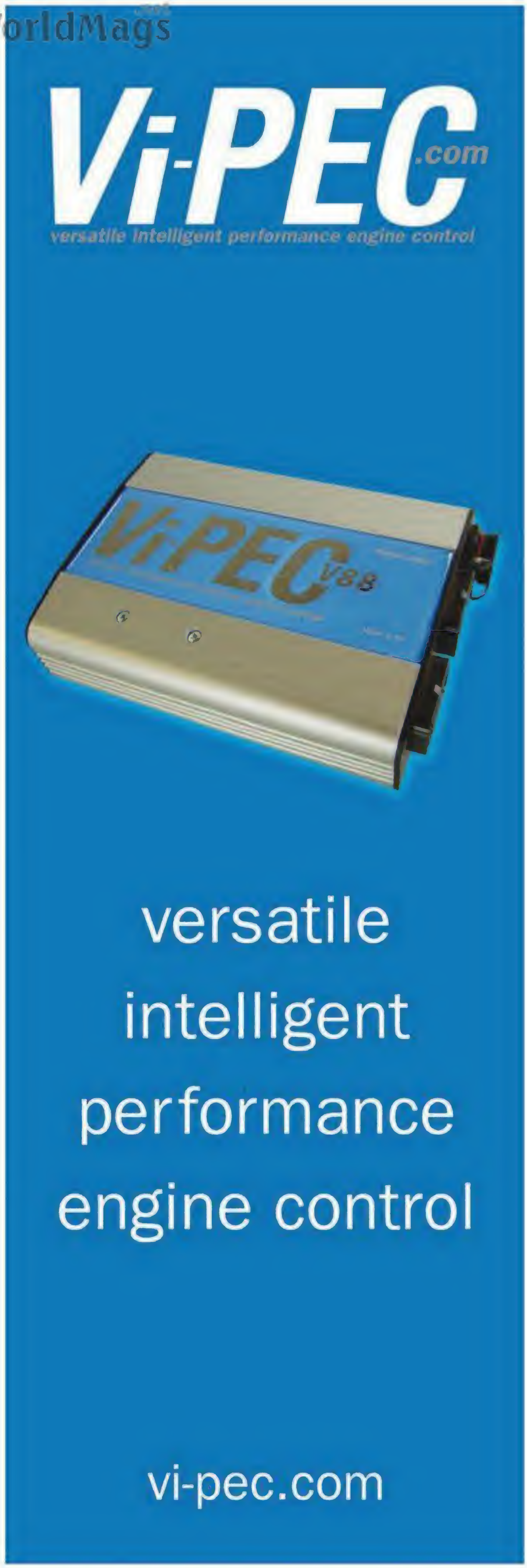
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Audi starts testing with R18 Hybrid

Audi Sport has tested a hybrid version of its R18, and plans to run it at Le Mans in 2012, according to reports.

Whilst precise details of the project are still unclear, it is known that it will utilise a flywheel hybrid powertrain. Porsche has allowed its sister company access to the Williams Hybrid Power system it plans to run in its forthcoming LMP1.

'Last year they [Audi] were asking the same questions that we were asking of ourselves three years ago,' revealed Hartmut Kristen, motorsport director at Porsche which ran a mechanical flywheel system in its GT3 R Hybrid. 'Since we are to a certain degree part of the same group, hopefully we speeded up their learning processes a little bit.'

The R18's mono-turbo diesel powertrain was claimed to be 'hybrid ready' when the car was launched, and engine chief, Ulrich Baretzky, is staunchly against battery-based systems.

A test team from Audi Sport has started the latest trial phase in the United States this week. After the previous tests of the further development of this year's Le Mans-winning car took place behind closed doors.

A statement issued by the German marque reveals that 'Audi Sport has been running tests with two vehicles at the Sebring (Florida) circuit. The second LMP1 Sportscar serves to compare the test results.'

It is thought that the updated car features a revised tub in an attempt to resolve the visibility problems suffered by the R18 this season. This would requir all new tooling from Dallara, so it may be given more than the R18H designation.

While the component tests have already started, Audi says it is not yet ready to announce the details of the 2012 racing programme, the driver line-up or the technical state of the development but, as soon as further details become available, *Racecar Engineering* will have the full story.

DC Electronics launches US facility

UK-based DC Electronics has launched a full production facility in Mooresville, North Carolina. The facility will be handling all aspects of a vehicle's electrical system, from initial design and production to roll out and ongoing trackside support.

DC Electronics is one of the motorsport industry's leading manufacturers of custom-built electrical systems, with 15 years' experience in the industry. The company has worldwide distributors for its products, ensuring it is at the forefront of innovation and technology on a global scale.

Products designed and built by the company have been used in championships worldwide, including NASCAR, Formula 1, World Rally Cars, Superbikes and even F1 Powerboats.

DC Electronics Inc will be servicing all of the North American motorsport markets, including NASCAR, ALMS, off road and Grand-Am. David Cunliffe, managing director of DC Electronics, commented: 'We are incredibly excited to be launching our full production facility in the US. We already have experience servicing NASCAR and ALMS teams and are looking forward to expanding our operations to enable us to service a greater number of clients in the US motorsport marketplace.'

RACE MOVES

who was just 44, also handled the team's PR and marketing and acted as a spotter for driver Timmy Hill, winner of the 2011 Nationwide Series rookie of the year. Mitchell joined RWR in 2009.

Peter Gethin has died at the age of 71. While Gethin is better known for his exploits as a driver, particularly his famous win in the 1971 Italian Grand Prix, where just 0.6 seconds covered the top five finishers, he was also team manager at Toleman in F1 in 1984 and ran his own F3000 squad later in that decade.

Dr Gian Paolo Dallara has been presented with a John Bolster Award at the Autosport Awards evening. The trophy, which was awarded in recognition of his technical achievements in motorsport over the past 50 years, was presented by Williams' director, Patrick Head.

Dr Dallara

LAT

Mike Ford is no longer crew chief to Denny Hamlin at NASCAR Sprint Cup outfit, Joe Gibbs Racing. Ford had been with Hamlin since the latter moved up to the Cup in 2005, and the pair came close to scooping the championship in 2010. Ford has accrued 21 race wins during his 12 years as a crew chief in the Cup.

Former grand prix ace, Gerhard Berger, has been appointed president of the FIA's single-seater commission. He replaces Formula 3 promoter, Barry Bland, in the position, the latter having stepped down due to personal reasons.

UK broadcaster, Sky, has announced its commentary team for its Formula 1 coverage, which kicks off this season. Martin Brundle steps over from the BBC, while he will be joined in the box by former BBC radio commentator, David Croft. Its pit-lane reporters will be Ted Kravitz and Natalie Pinkham.

Former F1 doctor, Professor Sid Watkins, has retired from the position of president of the FIA Institute, a role he has filled since the organisation was formed. Gerard Saillant steps up from deputy president to replace Watkins, while Garry Connelly takes on Saillant's old post. Watkins will keep an involvement with the institute as honorary president.

Former F1 mechanic, Charlie Moody, has passed away. Moody came to Formula 1 with Wolf in 1977 and subsequently worked for Fittipaldi, Williams, Benetton, Leyton House and Simtek. After a stint in Touring Cars and a brief return to F1 with the Williams' test team, Moody switched to MotoGP in 2001.

IndyCar official, Brian Barnhart, has been removed from the position of chief steward and director of racing and will no longer be involved in the officiating of the races. The move follows some controversial decisions this year, including re-starting the race at New Hampshire when the cars were on slicks and conditions were wet. Meanwhile, commercial president, Terry Angstadt, has been replaced by Mark Koretzky.

Renowned Formula 1 and Sportscar designer, Tony Southgate, is the new president of the 750 Motor Club, replacing veteran motoring journalist Bill Boddy MBE, who died last year. Southgate, 71, actually started his motor racing career with the club, competing with a self-built special in its 750 Formula in the '50s.

Tony Southgate

LAT

Well-known engineering writer, Michael Scarlett, has died at the age of 72. A qualified engineer, Scarlett worked in the motor racing industry at Cooper, Brabham and Hewland, before beginning a very successful career as a journalist.

Moving to a great new job in motorsport and want the world to know about it? Or has your motorsport company recently taken on an exciting new prospect? Then send an email with all the relevant information to Mike Breslin at bresmedia@hotmail.com

Silverstone to create much needed jobs

Historic British track given the go ahead to develop for the future

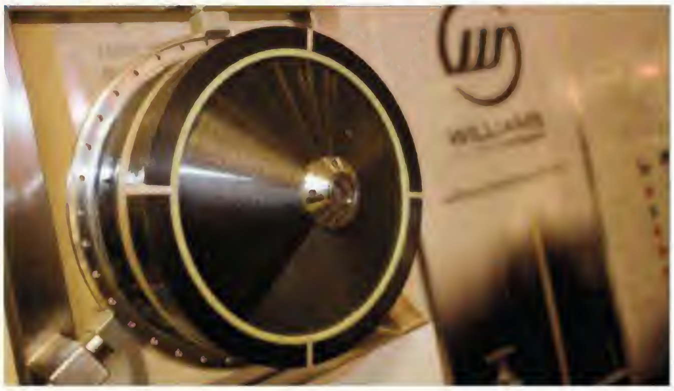
The heart of England's motorsport valley has received a major boost, after planning permission was granted for Silverstone's 20-year development plan.

The development includes a business park, education campus and three hotels. Silverstone's operators hope that companies will be attracted to the site and that it will create around 8,400 permanent jobs over the next 20 years, plus an average of around 550 construction jobs per annum throughout the development phase. At least 4,800 of these jobs are likely to be entirely new to the area.

Companies showcase new technology

Faro Technologies, Flybrid Systems, Millers Oils, Northamptonshire Enterprise Partnership, Oxford Brookes University, Ricardo and Williams Hybrid Power have all confirmed they will be showcasing at the International Low Carbon Racing Conference on Wednesday 11 January 2012 at the NEC Birmingham, UK. The highly-successful engineering showcase display is a key element of the conference, situated within the main conference room, giving maximum exposure to the products on display.

The conference will feature current low carbon and electric technologies / vehicles, giving businesses an ideal opportunity to promote their 'green' products to key industry figures and over 200 international delegates.



New technologies, such as Williams' hybrid power flywheel will be on display

Brembo celebrates 50 years of business

Italian brake manufacturer, Brembo, is celebrating 50 years in business, confirming its continued quest for innovation with a string of motorsport successes during 2011. Among these are 12 victories in the Formula 1 World Championship that saw Sebastian Vettel and the Red Bull Racing Team successfully defend the Drivers' and Constructors' titles won in 2010. Involved in Formula 1 since 1975, Brembo is able to boast 205 grand prix race wins, making up a total of 17 World Championship Drivers' titles and 21 World Championship Constructors' titles, achieved with the top teams. Also in 2011, there have been world titles in the FIA GT Championship, the Le Mans 24 Hours and the new Super 2000 World Rally Championship, as well as European and Italian Rally Championship titles. Other international successes include titles in GP2, GP3, F3 Euroseries and in the main championships and trophies for GT cars.

In addition, there was total domination in two-wheel racing. The title-winning machines in MotoGP, Moto2, 125, Superbike, Supersport, MX1, MX2 and Enduro off-road were all equipped with Brembo brakes.

There's no stopping Brembo in its quest for innovation in motorsport

Penny and Giles appoints French distributor

Penny + Giles, a business group of Curtiss-Wright Controls and designer and manufacturer of precision joystick controllers, sensors and solenoids, is continuing to strengthen its global distribution network with the appointment of French distributor, Wimesure. Wimesure has agreed to work with the retiring distributor, IC Mesures, for a transition period of at least six months. Jacques Maye (IC Mesures) will be working as a consultant with Wimesure, having distributed Penny + Giles products in France since 1995. Commenting for Wimesure, which has a network of 12 regional distributors throughout France, managing director Christophe Bracon said: 'As a technical distributor we are keen to expand our portfolio and Penny + Giles was identified as offering a broad range of high quality products that complement our existing range. We received full product training from Penny + Giles on its range of joystick controllers, solenoids and sensors, which has equipped us to offer specification and application advice to OEMs.'

MARLEY LANE BUSINESS PARK

A Centre of Excellence

Zapa Consulting AG have identified the need to move small but high-quality historic and motorsport-related companies upwards out of limiting premises onto a dedicated site where they can thrive. The aim is to create a centre of excellence with shared ideals and synergy between the tenants. By creating these conditions, each company can only boost the prospects of the others.

THE NEED FOR QUALITY

Quality matters to us

It is very much Zapa Consulting's aim to maintain a consistently high standard for the site. This applies not only to the general appearance and maintenance of the Business Park itself, but to the quality of product, demeanour and standing of the companies who are its tenants. This all contributes towards the responsible image all motorsport companies would wish to strive for.

SUITABLE TENNANTS

We are open-minded

Examples of what we have in mind might include a race team, a rolling road, a machine shop, a coach trimmer, a data-logging company, a roll cage manufacturer and so on.

Not only will the tenants support each other with their shared interests and ideals they may well be able to provide practical services to each other in the most convenient way. With the companies on site so far there are already diverse facilities available including painting, body repair, fabrication, panel beating, crack detection, chassis set-up equipment, tyre fitting and a dynamometer.

THE FUTURE

It's good news!

Planning permission exists for the erection of further buildings totalling approximately 30,000 sq ft on this site. These can either be tailored for future tenants wishing to share in this motorsport centre of excellence, or to accommodate expansion of the existing companies already on the site. Zapa Consulting will monitor the needs of its existing tenants and will be happy to discuss proposals from prospective tenants.

THE SITE

Marley Lane Business Park is a private site with excellent communications, being placed only a few hundred yards off the A21, affording direct connection with the M25 and literally 5 minutes from Battle railway station situated on the Hastings to Charing Cross line. The site itself is in a pleasant rural setting, very well presented, secure and surrounded by trees. It has planning permission to erect further buildings in future to meet demand.

At present we have 5 units:

Woodcote 18000 sq ft occupied by a leading historic race preparation company.
Fordwater 4500 sq ft occupied as a classic car storage facility.
Mulsanne 3000 sq ft occupied by a high-quality specialist car paintshop.
Paddock 4500 sq ft available.
Arnage 3000 sq ft available.

For further information contact:
Jan Boakes – Site Manager Tel: 07584 284136 and 01424 870600
or email: jan.boakes@zapaconsulting.com

ZAPA CONSULTING

ZAPA Consulting AG
c/o CKL Developments Ltd,
Woodcote,
Marley Lane Business Park,
Battle, East Sussex TN33 0RE
Tel: 01424 870600

Balancing act

Mark Raffauf is a straight talking American, and sets the record on Grand Am, balance of performance, and controlling wayward drivers

As the field of cars headed towards the start line of the final round of the FIA GT1 World Championship race in Argentina, there was an almighty accident that wiped out five cars. Up in the stewards room, the man the drivers had to face was Mark Raffauf, managing director of competition at Grand Am, and a man who had experience straightening out the driving habits of some of the sports 'wilder' pilots.

Raffauf has a reputation of being a straight talker, and there is no nonsense when it comes to setting out the law for drivers. 'Yep, we straightened [Jan Magnussen] up, and stopped Max Angelelli from hitting everything but the tow truck,' says the American, who sent Magnussen on a community project with children, or 'finger painting' as the Dane put it, after he was accused of causing an avoidable accident. 'You could have lifted,' he was told, to which he replied, 'You don't know me very well,' before signing up as a factory Corvette driver.

'I had to dock Negri a race, McDowell, Colin Braun, I said you can crash all you want, just do it on your own. If you take someone with you, you are going to hear from me,' says Raffauf. 'There are guys like Angelelli, who is the best braker I have ever seen, and I have been doing this for 30 years. He has the skill that allows him to outbrake people in places they don't expect without touching them. That is what it is all about, which is why we use 14in steel rotor [disc] brakes - lousy by European standards, but braking distances are longer, and a driver can do it.'

THESE ARE KEEPERS

The new Daytona Prototypes are better looking than their predecessors, but Raffauf says he is looking for longevity in the equipment. With a quick change of a rollcage and some new bodywork, the old cars can easily be adapted and the teams can continue to compete.

'The new car is essentially the same as the old one. In fact, two of the five Corvettes are built on the same car - one on a Riley and one on a Dallara chassis,' says Raffauf. 'They are easily made into that configuration. You can build a new car, but it is not necessary to do that. You can reasonably put on a new body and rollcage quickly and relatively inexpensively. It is basically cutting the old rollcage off and putting in a different one, with new attachment points. It is a fairly easy thing that the constructors can do it in less than a week.

Converting an existing car into a new generation Daytona Prototype is a quick, relatively inexpensive solution that gives teams longevity

"You can put on a new body and rollcage quickly and relatively inexpensively... the constructors can do it in less than a week"

'We realised that with 500bhp, at somewhere like Daytona, you can do more than 200mph, and we didn't see where that added much to the entertainment. So we made some changes - with things like a big frontal area and vertical sides. This bodywork is extremely functional.'

With Raffauf in the swing of things, it seemed an opportune moment to tackle the issue of performance balancing. This year, Ferrari and Audi will race in the GT class with their modified GT3 cars but, with costs and balance in mind, what was the American's approach? Simple. Limit their power to 500bhp. As with the Daytona Prototypes, engines are submitted for testing at the Concord Dyno Tech Center, and the aero is tested at the Windshear wind tunnel. Parity is observed, and the cars are then passed to race.

'What we did was take GT3-derived cars, and we looked at power and aerodynamics. After working with them - in the case of Ferrari, from its inception or, in the case of Audi, after they built the GT3 - we said, "this will work, if you take the extra 150bhp out of it, and if you take the aerodynamics down a step or two." They said that is not that hard to do.

'There are no rules in GT3. You can build what you want, run it, and then they have to figure out how to balance it. We do it the exact other way. The Audi V10 will be on our dynos, the same as the Ferrari V8 was, and the Dodge 8.0-litre, long before it is seen in competition, and we decide how it is going to run. The response from Ferrari when we asked is that you could run this engine for the year.

'I saw pictures of the new Aston Martin GT3 car, which is supposed to be a 750bhp V12, but how many gentlemen drivers should drive that? That is my personal comment. If that is the marker you are going for, you are crazy. You don't need to do that to go fast. If that is for pros, but how many gentlemen should be doing that?'

Criticism is often levelled at the American racing scene for its lack of technological advances - NASCAR has only just gone to fuel injection, for example - and, as European manufacturers look to alternative drivetrain technologies, will Grand Am follow suit?

'Our emphasis and focus is on competition, and it would be really cool to demonstrate new technology but, if there is no competition, you cannot sell tickets or show it on TV. And without the ability to do that, it is not competition.

LEVEL PLAYING FIELD

'With all due respect, if you don't have that package, you are there for fourth or fifth at best. In DP, every guy there has the chance to win the race. It is up to the people, the teams and the drivers to execute the competition. That is what the sport is about. People compete against people, and it is a team game. If one team is playing with a different ball, that is not our philosophy to do that.

'Does it mean that we won't? No, it means we don't know *how* to do that. We will embrace the technology, but how, and in what form, I don't know.'

What if someone developed an off-the-shelf KERS system? 'As long as mechanics weren't getting electrocuted and stuff like that. There are all those stories, which are true. We are not closed minded, but we are business like, and we have stockholders, so we have to make intelligent decisions for ourselves, race tracks and participants. The track has to be successful or you have no place to race. We have to bring television, the competitors have to have a viable, sustainable programme that is not millions of dollars a year, and our track record is pretty good.'

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Photography LAT, Gavin D Ireland, Rachel Schadle
Deputy Managing Director Steve Ross
Tel +44 (0) 20 7901 8011
Email steve.ross@chelseamagazines.com
Head of Business Development Tony Tobias
Tel +44 (0) 207 901 8026
Email tony.tobias@chelseamagazines.com
Senior Ad Sales Executive Lauren Mills
Tel +44 (0) 207 901 8026
Email lauren.mills@chelseamagazines.com
Publisher Luke Bilton
Publishing Director Sarah Arthur
Managing Director Paul Dobson
Editorial Racecar Engineering, Chelsea Magazine Company, Liscartan House, 127-131 Sloane Street, London SW1X 9AS, UK
Tel +44 (0) 207 901 8000
Advertising Racecar Engineering, Chelsea Magazine Company, Liscartan House, 127-131 Sloane Street, London SW1X 9AS, UK
Tel +44 (0) 207 901 8000
Fax +44 (0) 207 901 8001
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Generation game

The Rolex 24 at Daytona awaits at the end of January, and will take place with a wealth of new machinery taking part - up to nine new generation Daytona Prototypes, with Ferrari and Audi in the GT ranks, and with the usual sprint finish almost assured.

I have attended the 24-hour race many times, and one of my abiding memories is the sight of a Ferrari 333SP on the banking, at night, weaving between the slower traffic. The infield between turns three and four at the Speedway is the perfect place to appreciate endurance racing. The difference in speed, the level of skill in negotiating traffic, and the sheer noise and speed of these cars was inspiring. James Weaver said that going into the braking area at turn one was like going into warp drive, as the bankers and dentists brake around 100m before the professional drivers in their faster cars.

Then came the Daytona Prototype (DP) era, and things changed. Already I had been threatened with arrest (twice - once in the pit lane by an armed guard), and been thrown out of Danica Patrick's pit because I was carrying a notebook rather than a television camera, so my view of Grand Am was soured.

"the sheer noise and speed of these cars was inspiring"

The cars were labelled 'Prototurtles' by one commentator, and were beaten to overall victory by Kevin Buckler's GT class Porsche in 2003. They were technically light years behind the Europeans, who were chasing green technology, bringing in the new manufacturers and, at the same time, staging that same fantastic racing.

Then, things got worse. The Daytona 24 Hours became a safety car zone, and only the last two hours were interesting. One year, a colleague and I hit the pub at 11pm on Saturday night, and were firmly settled at the bar when Gaston Mazzacane went off and hit a lamp post on the infield. We watched on television as the safety car came out and racing was suspended, then we stopped watching altogether. When we returned early the next morning, we had missed nothing. This became our ritual, until flight prices started rising, interest waned, and I stopped going.

None of the drivers could understand my lack of enthusiasm and, when I went to Daytona in December to see the new generation DPs, Joao Barbosa asked whether this signalled a change of heart.

Certainly, the next generation Daytona Prototypes look a lot better, but the running gear is the same (in many cases the cars themselves are the same, with just a new roll cage and body kit), and the ethos is the same safety car zone of manufactured close finishes. It is a world apart from the American Le Mans Series and, given the choice of winter trips to Florida, Sebring wins every time. The Sebring 12 Hours has seen some outstanding racing, big name drivers and, held on the Spring Break weekend, a massive crowd that loves to see the cars, the racing, and get involved in the alternative lifestyle of Green Park.

Yet the France family is in it for the long term, and longevity is critical to its success. It is working, and with good-looking cars that can travel at 180mph on the banking, is it time to reconsider my position on Grand Am?

'We have cars out there that are doing their seventh Rolex 24, cars that have more than 40,000 racing miles on them, and they are still capable of being on the front row,' says Managing Director of Competitions, Mark Raffauf. 'Our position is that when people make an investment, they need to be able to use it. Keeping the cars stable, rules stable, and fighting off the temptation to do new stuff has allowed us to weather a downturn pretty well. It is still attractive because it is still reasonable.

'There will be nine new cars at Daytona. Add that to incredible growth in GT, with Audi coming, Ferrari and another manufacturer with an 8.0-litre engine we can live with. GM is already there, along with Mazda, BMW and Porsche. GT is probably the most diverse group of major manufacturers, all with a chance to win, which is more than anywhere at any time.'

The Daytona 24 Hours is again a drivers' race. The cars look better, the manufacturers can start to show off their styling cues for future models and, if Grand Am can get the media back on board, Daytona could become a great race again. Certainly it is worth a second chance but, if you spot an Englishman nursing a beer in the Irish bar on Daytona Beach at 11pm on Saturday mid-race, you will have your answer.

EDITOR
Andrew Cotton